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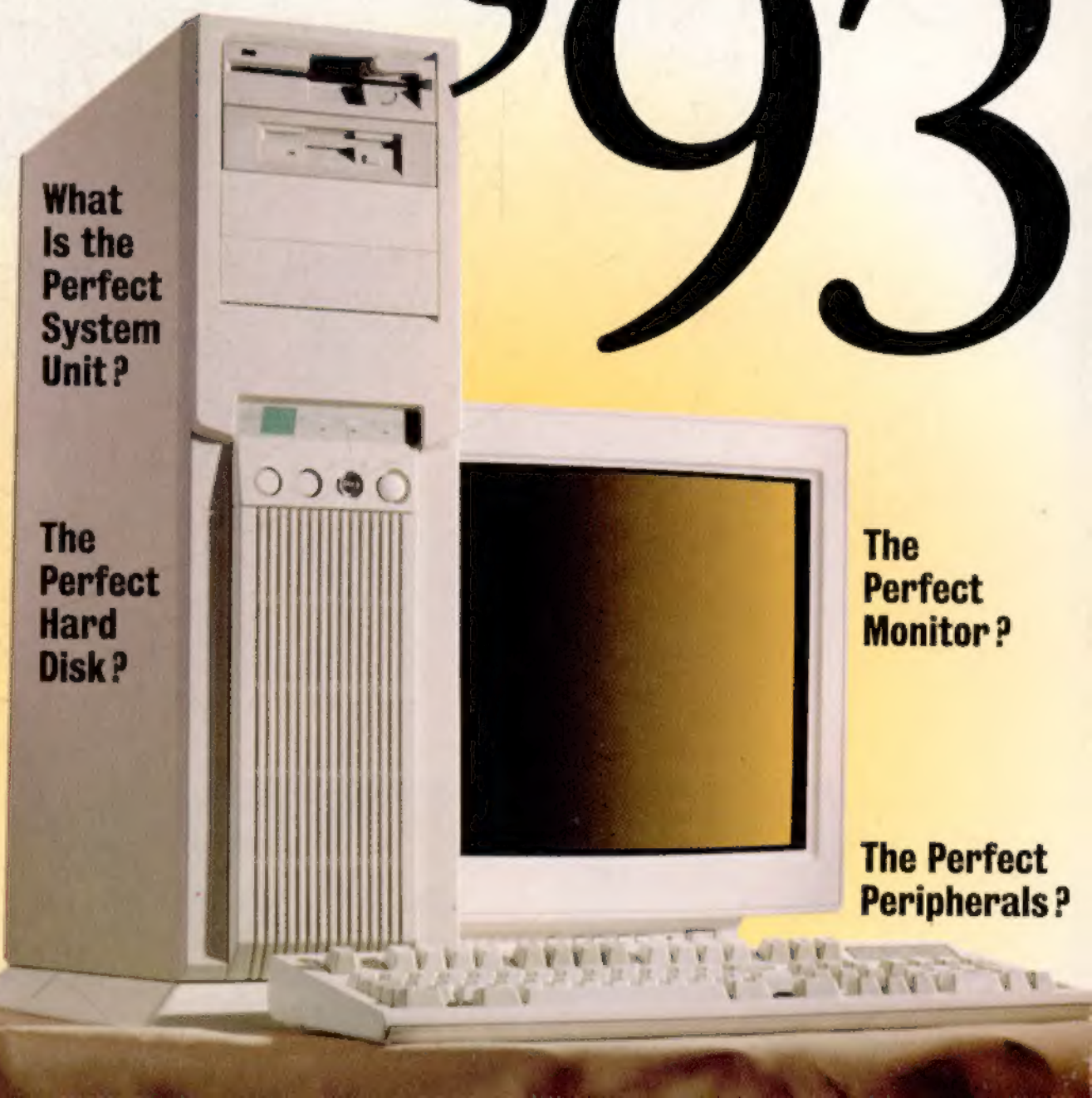

it'll BE in your face

All day every DAY

CIRCLE 157 ON READER SERVICE CARD

SURE, ALL SPREADSHEETS
ARE PRETTY MUCH THE SAME.
AND THIS IS JUST A STICK.
TRADE MARK
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LOUISVILLE SLUGGER

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Which brings us to our final point, for which we'll refer to that unassuming piece of wood on the other page.

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Microsoft Excel is available separately or as a part of The Microsoft Office.

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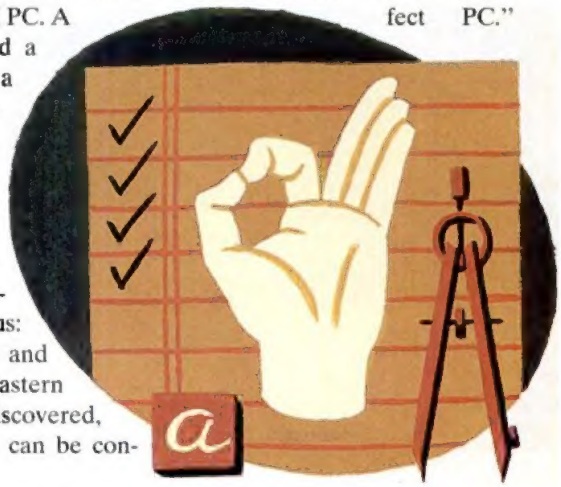
Inside

What is perfection? For the computer user, it's as elusive as sighting the yeti, attending a perfect ball game, or having a computer that doesn't crash. The serenity it brings has eluded those of us who spend a lot of time in front of a computer screen.

Selecting a PC in 1981 was a throwback from the days when Henry Ford would sell you any color Model T, as long as it was black. If you wanted MS-DOS, you bought an IBM PC. A year later, you had a second choice: a Compaq. In our time, the choices seem overwhelming, with hundreds of vendors vying for our attention. The broad benefits are obvious: freedom of choice and low prices. But as Eastern Europeans have discovered, too much freedom can be confounding.

To help you sort through these confusing options, we launched the "Perfect PC" issue last year. Instead of our usual focus on product reviews, we walked you through the decision process of selecting the most perfect PC for the task you had to perform. The issue was a huge success. Not only were your responses extremely positive, but the issue was the biggest newsstand seller in the history of *PC Magazine*. It reminded us that even readers with your technical sophistication can use a little help in hacking a path through the thicket of computer products and choices available today.

Our cover story in this issue is the 1993 version of "The Perfect PC."



The number of options is even greater than last year. Which flavor of CPU do you need? Should you have ISA, EISA or VL-Bus? What is the correct graphics card? How much memory should you have? What kind of hard disk? Should you upgrade instead of buying a new machine? Perfection may continue to elude us, but we think that this issue of *PC Magazine* brings us one small step closer to computer nirvana.

—Joel Dreyfuss

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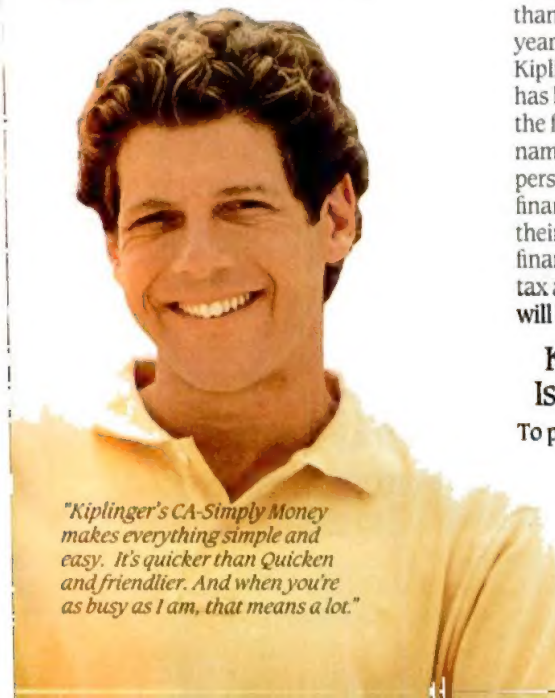

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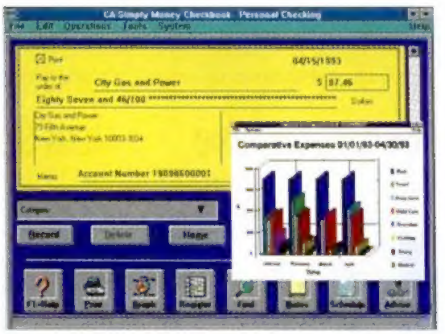

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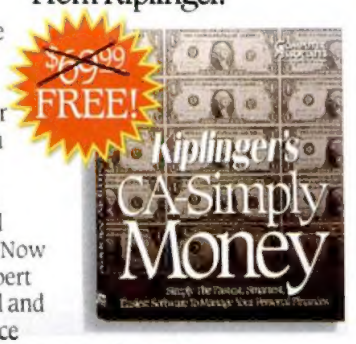

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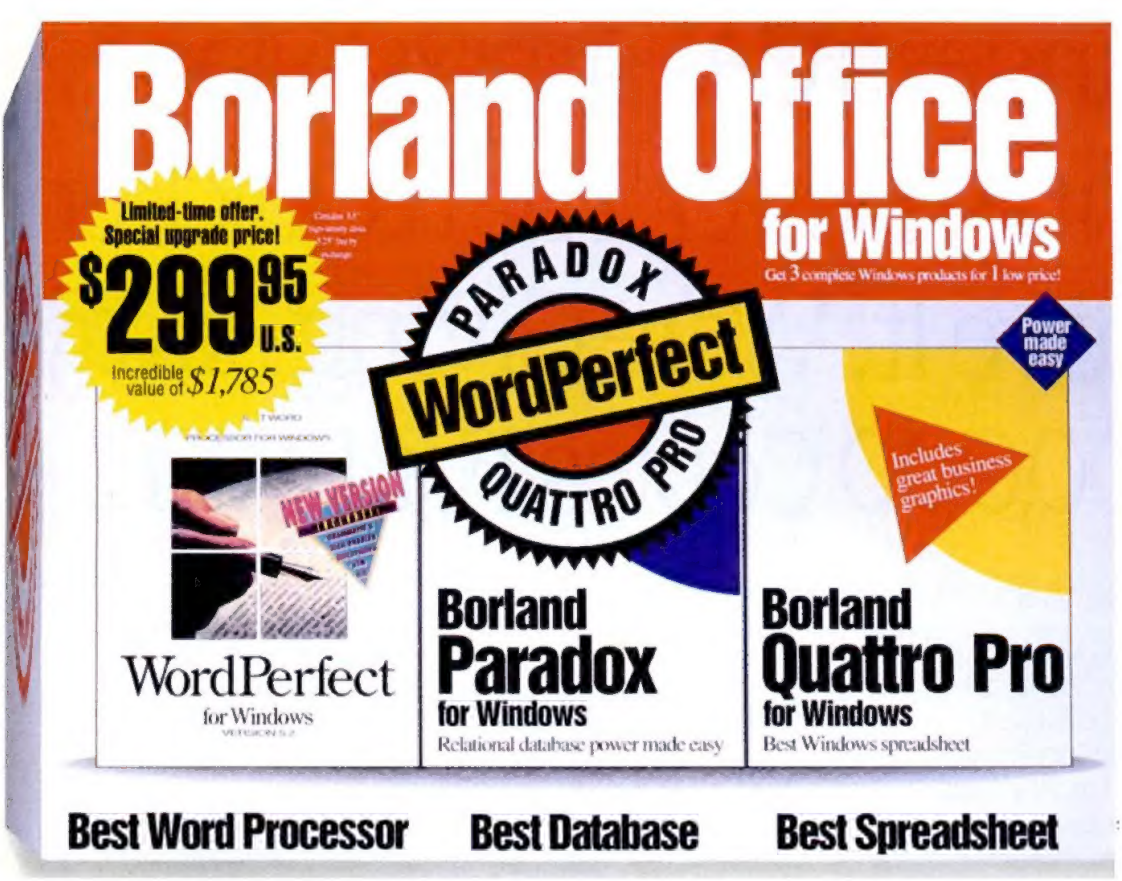

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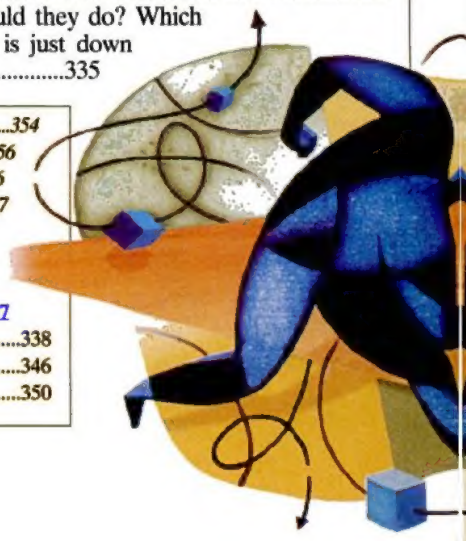

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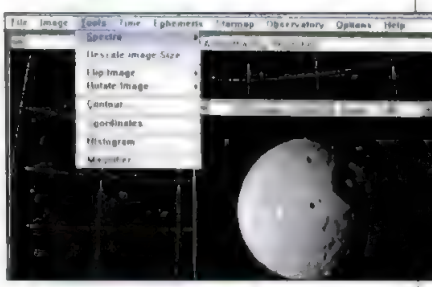

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BY DON WILLMOTT 550

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Backup people

If you wanted to create an important new version of the world's best-selling backup software, who would you ask for advice?

How about people who'll use it?

That's what we did.

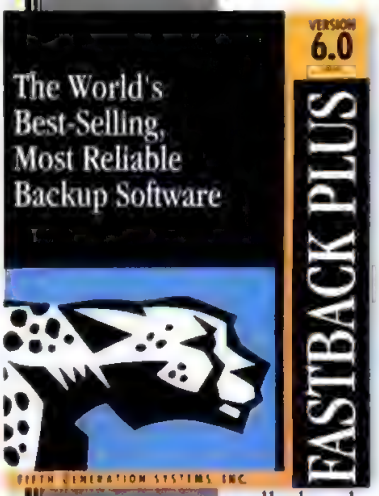
We surveyed over 2,000 people and based the prototype of Fastback Plus Version 6.0 on their input.

Then we invited 40 users – novices, propellerheads, people who swear by Fastback, people who swear at it, and people who swear they've never seen it – to visit our offices and work with us personally.

During 30 days of interface design and usability testing, we ran up some hefty hotel bills. And learned some valuable lessons.

We learned, for example, that our installed base is nostalgic for the simple, straightforward, everything-available-at-a-glance

DOS
Windows
UNIX
Macintosh



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of the people, by the and for the people.

interface we used all the way back in Version 2.0.

We learned that while some prefer to select files by typing in specs and others prefer to point and click, everyone wanted a choice.

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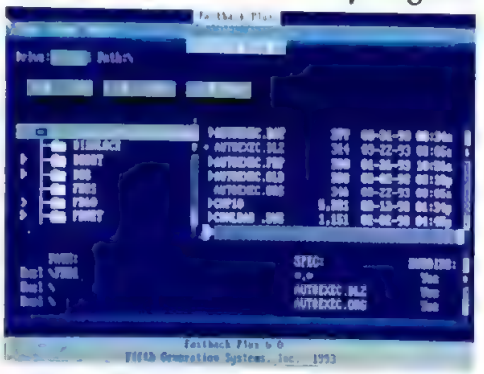

Choosing files for backup couldn't be more flexible. From a single screen, you can type in specs for the files you want and back them all up at a keystroke, or simply point and click.

As you can see, Version 6.0 combines enhanced functionality with refreshing usability. Options are logically grouped and everything, including your settings summary, is in plain English.

They wanted an Express menu with improved screens, simplified file selection and a Compare function. With separate menus for Backup and Restore.

And while they were on the subject, our subjects insisted that restoring should be as simple and as effortless as possible.

They weren't kidding, either.

After they'd selected the file they wanted, they figured Fastback ought to tell them when it was backed up, what type of media it was backed up to and what type of backup it was.

"Anything else?" we asked.

"Sure," they said, and asked if Version 6.0 could do dishes and take out the trash.

We said it couldn't, but when we told them it could do all the things listed in the box on the left, they were delighted.

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CIRCLE 288 ON READER SERVICE CARD

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Senior Editors Christopher Barr (West Coast), David Greenfield (Networking and Communications), Trudy Neuhaus (Technical Columns), Don Willmott (First Looks)

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If you are dissatisfied with a product advertised in *PC Magazine* and cannot resolve the problem with the vendor, write (do not call) Jennifer Roth, Advertising Department, at the above address. Include copies of your correspondence with the vendor.

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To obtain the utility without ZiffNet connect charges, at the HOST NAME prompt, enter CIS. At the USER ID prompt, enter 60116,1. At the PASSWORD prompt, enter PCMAGUTIL. To join ZiffNet, at the Host Name prompt, enter CIS. At the USER ID prompt, enter 177000,5000. Enter PC*MAGNET at the PASSWORD prompt and Z11D9200 at the ENTER AGREEMENT NUMBER prompt. CompuServe members may join by typing GO PCMAG at any CIS prompt. For Customer Service, call 800-848-8990. ZiffNet membership is $2.50 a month, which includes access to *PC Magazine* Editors' Choice Awards, Product Reviews Index, weekly news from PC Week, Buyers' Market, and ZiffNet Highlights and Information. Hourly connect charges are $6.30 for 300 bps, $12.80 for 1,200 or 2,400 bps, or $22.80 for 9,600 bps.

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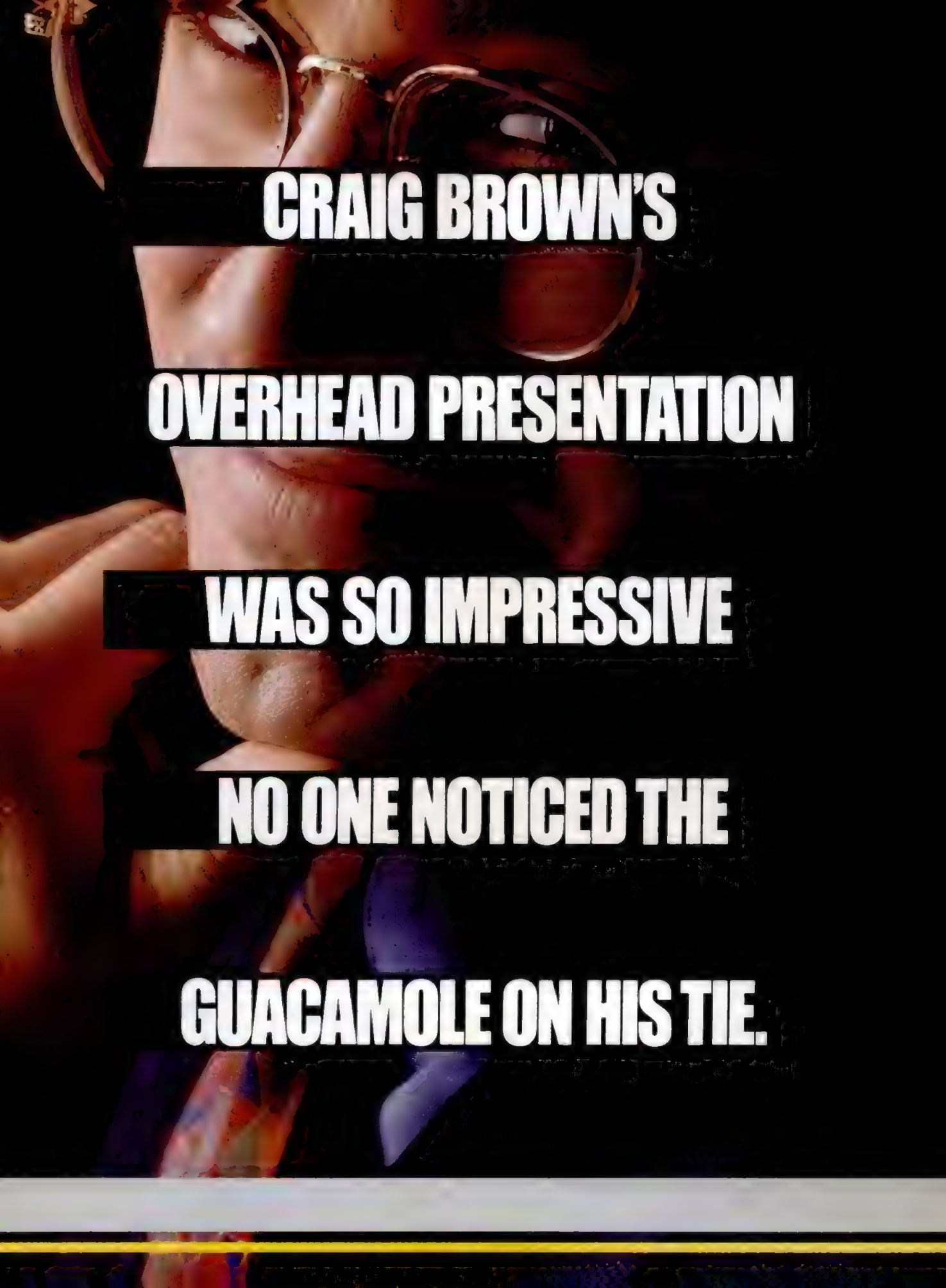
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In Mr. Magoo's case, what he can't see covers lots of territory. For the rest of us, it includes things like invisible electronic emissions.

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For this, Samtron's extra charge is zero.

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It's a difference even Magoo can appreciate. Take our new flat-screen 15" color monitor (SC-528DXL), for example. Together with a fine-grained 0.28 dot pitch and 1,024 x 768 high resolution, it gives you a picture that is not only steady, but crisp and clean.

The same can be said of our economical 14" color monitor (SC-428TXL). Both are VGA and VESA compatible.

As we said, they all come with VLMF. Plus something else worth looking for.

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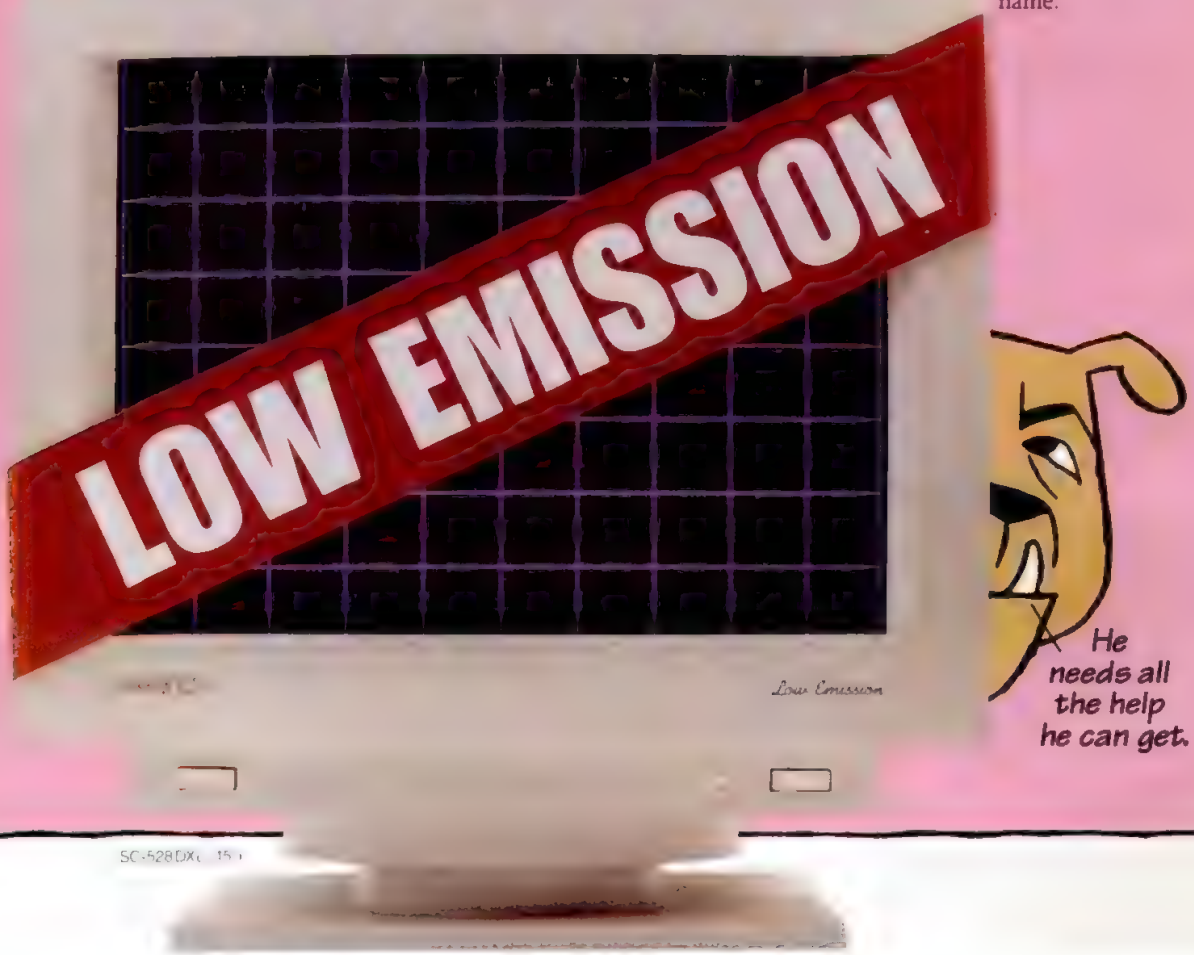

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CIRCLE 296 ON READER SERVICE CARD

Letters

WE'RE HERE FOR YOU

Speaking for every Zenith Data Systems employee, I think it's fair to say that we were disappointed and concerned by your readers' below-average rating of the company in the Service and Reliability survey ("How Good Is Your PC?" February 9, 1993).

We are determined to improve ZDS's rating in future surveys and would like your readers to know some of the steps we have already taken to increase their level of satisfaction.

We have instituted a toll-free ZDS Customer Assistance Center (800-CARE-360) with highly trained technical specialists. In March we expanded the staff by 50 percent to reduce waiting times.

We've introduced a heightened emphasis on product quality in the design process, while significantly extending our product testing. We're confident that our product quality is now equal to—and in many cases, better than—industry norms.

As a signal of our commitment to customer satisfaction, we would like any reader who responded to your surveys and had a less-than-positive experience with a ZDS PC or authorized service center to contact us at a special toll-free number (800-532-8115). That way we can address any outstanding issues while determining if there are additional actions we need to take.

Rich Davison
Vice President,
North American Customer Service
Zenith Data Systems
Buffalo Grove, Illinois

CAN WE SURVIVE THE SOFTWARE PRICE WAR?

In response to Michael J. Miller's column, "$99: Why Pay More?" (May 11, 1993), there are many these days who advocate "$99" software, and the argument that there are 80 million potential users is an interesting one. But let's look at lifecycle costs to develop, market, maintain, and provide quality service to customers. If you work through the numbers, you'll see—as many of us on this side of the fence do—that you simply cannot provide decent service to customers, regardless of the numbers, for the kind of street prices you advocate. Don't assume that everyone is on the buying end of the equation. Some of us are on the other end, and an extension of the price war of the last few years into our area will simply kill many of us.

Michael J. Miller

$99: Why Pay More?

You've seen the ads: Microsoft Access for $99. Borland's Paradox for Windows for $139. Quattro Pro for Windows for $99. Lotus Improv for $99. Looks like the $495 software package may be going the way of the dinosaur. That may not be such a bad thing.

"You can't provide decent service for the street prices you advocate."

Donald E. Killen
Dallas, Texas

IT'S ALL IN THE CARDS

Once again you outdid yourself with your excellent review of almost all the sound cards on the market ("Sound Boards: Coming of Age," April 27, 1993). No other magazine I have seen (including multimedia magazines) has the guts to cover so many cards in so much painstaking detail. For the first time I feel I have a grasp on the abilities and precise audio performance of the many choices.

Alex Randolph
Rochester, Minnesota

GOING ALL THE WAY...

I appreciated Bill Machrone's column, "A Little Help from Our Friends?" (April 27, 1993), because it showed me the lengths PC Magazine Labs and ZD Labs go to in order to provide the most accurate and informative product reviews possible. However, one point bothered me greatly. In Mr. Machrone's discussion of how some vendors "cheat" the benchmark tests, he deliberately avoided naming one vendor that had hard-coded the benchmark test string into its device. Whether this was by personal choice or by mandate, it was clearly an error in judgment. This is *exactly* the type of information that your readers need to know to make an informed purchase. I know that I personally would not buy a product from a company that had tried to deceive me in order to make a sale.

Gordon K. Daily
Herrin, Illinois

ON THE CONTRARY

Your "BBS Software Update" (April 27, 1993) incorrectly reported that there was no significant upgrade to RBBS-PC in 1992, and that the current release is 17.3C On June 20, 1992, RBBS-PC 17.4 was released with over 40 enhancements. The most significant enhancements include full support for carbon copy and distribution lists for messages, personal uploading of files to individuals and distribution lists, the ability to execute message commands globally over all selected conferences, support for banking time from one session for later use, tagging for both messages and files, automatic detection of ANSI support before log-on, and the ability to give subscriptions by total amount of time used rather than just by date.

Ken Goosens
Co-author, RBBS-PC
Fairfax, Virginia

PENTIUM POLICE

I was very disappointed in your article, "Pentium Power," in the April 27, 1993, issue. I have a Pentium chip and its performance is *far* short of what you found. It executes my applications in the same time as an ordinary 486-DX2/50 (about 8 to 12 hours per run) and is significantly slower than a 486-DX2/66. I also have a 50-MHz 486DX2-based TI Travelmate 4000 WinDX2, which operates my appli-

EVEN as his model aircraft *screamed* into the oak, our AST designer remained PREOCCUPIED with *thoughts of PCs.*

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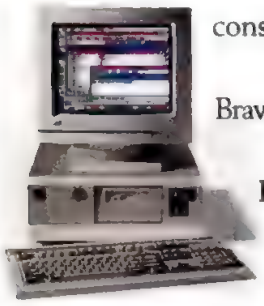
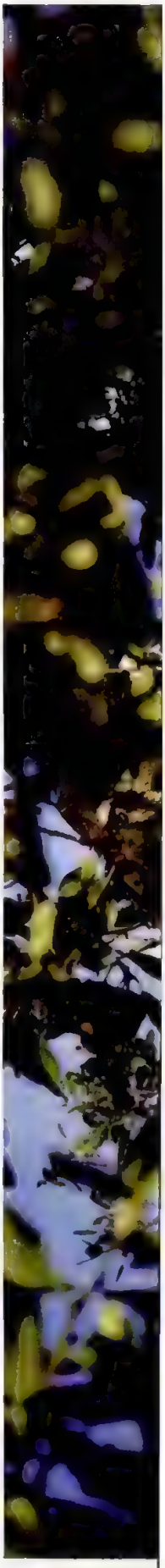


consider the results: the third-generation AST Bravo desktop PCs. With Bravo, our engineers addressed the issue of PC price/performance head-on. First, they enhanced Windows™ performance. Then, they improved reliability while reducing costs by creating an upgradable, four-layer systemboard that's half its previous size. It's just one more example of how AST has been setting PC standards for over 13 years. In fact, our latest Bravo series has already won the praise of *BYTE, PC World* and *InfoWorld.* While our flying has won the praise of, well...



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LETTERS

cations at the same speed as the Pentium. In fact, for one app, the TI laptop is twice as fast—and with many more disk reads.

Stanley E. Turner
Palm Harbor, Florida

When I read your April 27, 1993, issue regarding the new Pentium CPU, I had to laugh. It's not even out yet, and some folks can't wait for the 686.

Come on, already! No sooner does the average PC owner buy a new machine, thinking it's state of the art, than he or she reads that the computer is a hopelessly underpowered lightweight that will be obsolete by sundown.

The fact is, most users need that kind of power about as much as they need a car with a 6,000-horsepower engine. For the average user who works in Windows and does spreadsheets, word processing, and other general chores, a 486 *more* than does the trick, regardless of what those who are never satisfied say. And who *really* needs Unix, OS/2, and Windows NT in the average office?

Jeff Conn
Denver, Colorado

WHAT PLANET ARE WE ON HERE?

I am writing in response to John C. Dvorak's column, "Dvorak's 1993 Minimum Machine," (April 27, 1993). I don't know what world Dvorak is living in, but it certainly isn't the real one. Where he gets the idea that businesses today—much less individuals—can afford to spend $4,100 on a computer system is beyond me. I love your magazine, and generally read it from cover to cover, but the one thing that always bothers me is that you, living in whatever world Dvorak lives in, seem to constantly forget that normal people have to pay for what they buy and that most can barely afford the $999 that they do spend.

Christopher Miller
Louisville, Kentucky

I was very encouraged when I read "Dvorak's 1993 Minimum Machine" because it was pretty close to the computer I am planning on purchasing (from Gateway, no less). However, just a few pages further on I read Bill Howard's column, "EISA + VESA: A Powerful Pair," and I began to have my doubts, especially since he singled out the ATI video card that comes with Dvorak's machine. Question is: Will the Gateway 2000 computer in Dvorak's article experience the video degradation that is threatened in Howard's article?

Steven Jukovic
Wheaton, Illinois

RETURNING TO EARTH

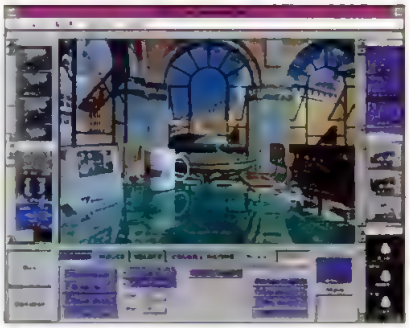
Bravo to executive editor Robin Raskin! In her Pipeline column in the April 27 issue, she has spoken for the average user. She has cut through all the hype, exposing some truths about CD-ROM, audio, and multimedia in general. The topics she discussed are often swept under the carpet while meager virtues are extolled.

P.F. McKittrick
Westford, Massachusetts

CORRECTIONS AND AMPLIFICATIONS

In our May 11, 1993, First Looks piece about the NEC Versa 25C ("NEC Versa 25C: Lasting Color) we printed an incorrect toll-free number for NEC Technologies. The correct number is 800-388-8888.

The screen image that accompanied our First Looks evaluation of Visual Software's Renderize program (May 11, 1993), failed to depict the photorealistic quality of the images that the Renderize program creates. An accurate, photorealistic image of Visual Software's Renderize is printed below.



Since NeXTStep for Intel Processors appeared as a Hot Prospect in the New & Improved section of the May 11, 1993 issue, the operating system's list price has dropped to $795. The NeXTStep development tools are available separately for $1,995.

In the May 11 Read Only section, we listed an incorrect toll-free number for obtaining the *PC Magazine Guide to Windows for Workgroups*. The correct phone number is 800-688-0448; the correct ISBN number is 1-56276-120-X.

The Summary of Features table for our May 11 review of relational databases ("Relational Databases: New Blood, New Power") incorrectly listed the number of records per file for Microsoft FoxPro for DOS and for Windows as 1 million. The correct number of records per file is 1 billion.

In our May 11 story, "Desktop Video: A Window On the Future," we printed incorrect information for CEI under the heading, "Where to Reach the Vendors." CEI is located at 3 Lagoon Dr., #350, Redwood City, CA 94065. The company's phone number is 415-591-6617; its fax number is 415-591-8310.

In After Hours (May 11) we printed an incorrect toll-free number for Io International Consulting, makers of Staying Healthy in the '90s: What Everyone Should Know About AIDS. The correct number is 800-367-6288.

The legend for our benchmark test results in the May 11 review of file servers ("To Serve and Protect") had the Dell and DEC graphs transposed. Dell's results were in fact better than initially represented.

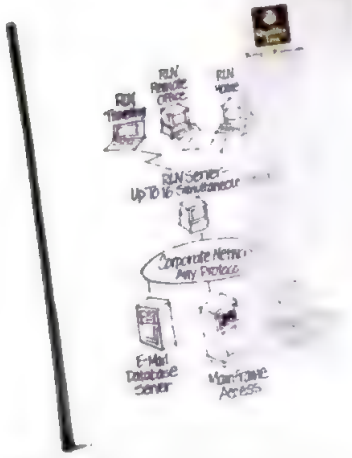
HOW TO WRITE TO PC MAGAZINE

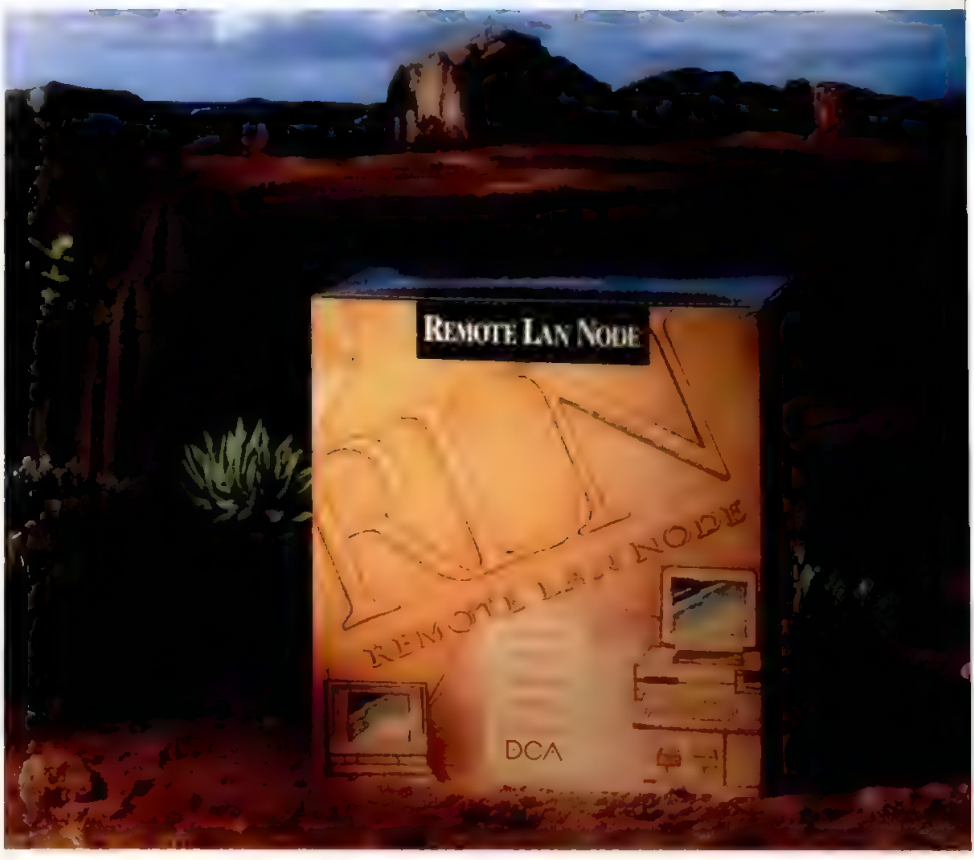
We welcome your comments and suggestions. Please send correspondence to Letters, *PC Magazine*, One Park Ave., New York, NY 10016, or upload it to PC MagNet (see page 12 for access information). All letters become the property of *PC Magazine* and are subject to editing.

WHEN REMOTE ACCESS PRODUCTS WERE TESTED IN THE ARIZONA DESERT, GUESS WHO HAD THE HOTTEST SOLUTION?

The test was part of a comprehensive analysis of remote network access solutions done by *Corporate Computing*. They packed up nine dial-in server products and sent a technician out to do some real field testing—in the town of Sedona, Arizona, pop. 7940.

He dialed in to the ZD Labs LAN in Foster City, California. And when he logged off, he had a winner: Remote LAN Node® (RLN™) from DCA®—a unique software solution that lets up to 16 remote users dial in at once and function just like locally connected PCs.





RLN PROVED IT COULD TAKE THE HEAT.

We'll let the article do the talking. "The best product was Remote LAN Node—a software solution that acts like a multiprotocol router when installed on a PC on a LAN."

The magazine went on to say, "Our winner, DCA's RLN, stood out for its capability to handle multiple communications protocols," commenting that "it won hands-down on flexibility, allowing our remote users to connect to both IPX and IP servers in the same call."

All in all, the article concluded, if you're looking for versatility, "None of the other units we tested came close."

THE BEST SOLUTION UNDER THE SUN.

Remote LAN Node extends the full capability of the network to remote users, allowing them to function as true remote nodes. RLN is both protocol- and application-transparent. So you can access any network protocol, such as IPX/SPX (Novell®), SPP/IPC (Banyan®), NetBEUI (Microsoft®) and TCP/IP—or any interconnected combination. And, as *Corporate Computing* pointed out, you can access them simultaneously.

You only dedicate one PC as a comm server for 16 concurrent users. And RLN offers three levels of configurable security, including the industry's first Remote Security Adapter.

CIRCLE 389 ON READER SERVICE CARD

GET IT WHILE IT'S HOT.

We've quoted *Corporate Computing* a lot. But we'd like you to see more than a few isolated sentences. So call and we'll send you a reprint of the article. We'll also send an informative booklet, "Just Like Being There—A Guide To Remote Network Access."

And finally, we'll send a free copy of RLN client software, so you can dial in to our LAN Lab server and judge for yourself.

You won't have to go to the desert. Or even leave your office. But you'll find yourself in a whole new world.

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THE FREEDOM TO COMMUNICATE.

DCA

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SEE US AT PC EXPO BOOTH #3360.

Toto, I Don't Think We're In Kansas Anymore.

INTRODUCING THE NEW ZEOS® COLORNOTE 486. FOR COLOR THAT'S BEYOND ANY RAINBOW.

Sometimes, the dreams that you dare to dream really *do* come true...Like owning a 486SX-33 color notebook that has all the right features. At a price that won't make you have to sell the family farm.

486SX-33 POWER.

ZEOS's new ColorNote 486 starts with a powerful, reliable Intel 486SX processor operating at 33MHz—not just 25MHz, like many other color notebooks. We've packed in enough power and memory to easily run Windows: 4MB RAM (expandable to 20MB), an 80, 120

or 180MB hard drive, and an 8K built-in cache—standard.

COLOR THAT'S COMPARABLE TO YOUR DESKTOP MONITOR.

For a crisp, vibrant color VGA display, the ZEOS ColorNote 486 employs a new technological breakthrough—*dual scan technology*—for color that's comparable to that of a great desktop color monitor. You get up to 256 colors with 512K of video RAM! What's more, your screen is backlit, 9.4 inches on the diagonal, and gives you up to 640x480 resolution.

Color technology can drain a notebook's power. So that you can get up to three hours—and beyond—of battery life, the ColorNote uses a Nickel-Metal Hydride battery. It also comes equipped with an *internal 1.44MB floppy drive,* plus a handy *PCMCIA slot*—the new industry standard interface that lets you plug in such devices as an internal fax modem, extra hard disk or a local-area network adapter.

We made sure the keyboard feels just like your desktop's, too—with 82 keys for fast touch typing, dedicated function keys and an imbedded numeric pad. And so you don't have to tangle with a mouse when you travel, the ColorNote features a comfortable, built-in trackball.

All this—at a mere 5.6 pounds, including the battery!

EPA POLLUTION PREVENTER

The ZEOS ColorNote 486 has earned the EPA Energy Star logo for its energy-saving capabilities. Which not only reduces the pollution generated from electricity, it saves you money.

SUPPORT THAT'S THE BEST IN THE BUSINESS.

Remember, your ColorNote 486 comes with customer support that's the best in the business. All ZEOS products are backed by 24-Hour-A-Day Toll-Free Technical Support, 365 days a year. You can always call us with your questions, any time of the day or night.

What's more, we give you a 30-Day Absolute Satisfaction Money-Back Guarantee and a One Year Limited Warranty. So you can buy from ZEOS with confidence.

Get the ZEOS ColorNote 486. There's nothing like a 486 color notebook. And for quality notebooks that are not only reliable but affordable, there's no place like ZEOS.

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ZEOS COLORNOTE 486

PACKAGE 1
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- Intel 486SX processor operating at 33MHz
- 4MB RAM
- 80MB hard drive
- 8K internal cache
- Dual scan LCD technology for bright, vibrant colors
- 512K video RAM
- Backlit, 9.4" screen, 640x480 resolution, up to 256 colors
- Supports co-display with external SVGA monitor
- Internal 1.44MB floppy disk drive
- PCMCIA slot (one type II or type III device)
- NiMH battery for increased battery life
- 82-key keyboard with dedicated function keys, numeric keypad
- Built-in trackball
- 24-Hour Toll-Free Technical Support
- 30-Day Absolute Satisfaction Money-Back Guarantee
- One Year Limited Warranty

PACKAGE 2
$2995
All of package 1, including:

- 4MB RAM
- 120MB hard drive
- DOS 6.0 with Enhanced Tools
- Windows 3.1
- Lotus Organizer

PACKAGE 3
$3395
Go up to

- 8MB RAM
- 180MB hard drive

Plus...

- Custom-fitted carrying case
- DOS 6.0 with Enhanced Tools
- Windows 3.1
- Lotus Organizer

Custom configurations and other accessories available. Call for details!

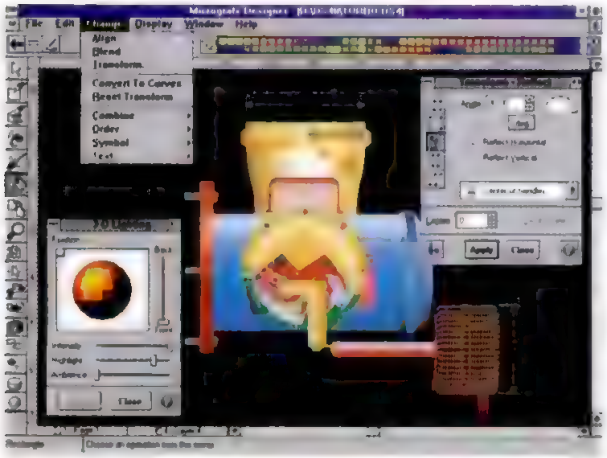
Copyrighted material

Ever met a designer that was quick, very precise, brilliant, and could handle any assignment, yet wasn't a complete pain in the butt to work with?

Now you have. Introducing Designer 4.0.

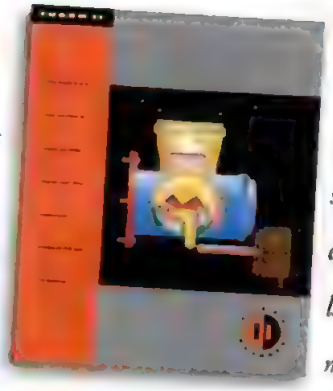
Say hello to Windows®-based software that delivers everything from hair-splitting accuracy in technical illustrations, to fast and powerful graphic design capabilities. It's all new Micrografx Designer™ 4.0, the illustrating package that's so advanced it'd be scary if it weren't so simple to use.

When you start talking precision, new Designer 4.0 is close to perfect, with symbol creation and placement to one micron. You get no less than 29 precision drawing tools. A wide array of advanced features includes direct entry of coordinates and dimensions, wireframe mode, and 32,767 layers, all of which keep you in control while creating, editing and manipulating symbols and text.



Designer 4.0's new intuitive interface is easy to learn and use with hint lines and context-sensitive help.

Designer 4.0 is just as powerful for graphics and design. Precise color creation starts with 4-color TRUMATCH® and PANTONE® color matching systems, continuing through to advanced color separation. Image group editing features include contrast, brightness, and color correction. Reshape objects quickly, even edit grouped objects without ungrouping. Text management is stress-free with 250 Type 1 and TrueType fonts, as well as single-step stretching, warping, and extrusion. Plus, linked text containers let your words of wisdom flow from one box to the next ever so smoothly.*



Complete graphic design capabilities range from powerful text management to advanced color creation and separation.

Now, while Designer 4.0 is filled with sophisticated features, you'll have it up and running in no time. A new streamlined interface means you can find everything fast. Hint lines, customizable tool bar, and more make this one quick and easy-to-use package. Call us today to find out more. After all it just may be the simplest way yet to put so much creative power to work for you.

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"DISK COMPRESSION IS INHERENTLY MORE FRAGILE... ...USERS OF COMPRESSION SHOULD HAVE A COPY OF NORTON UTILITIES 7.0."

PC Week - May 10, 1993

Peter Norton, the leader in data recovery software.

The new compression technology can put you in a squeeze. You wanted the efficiency, but now you're worried about losing data.

Here's some news that might help you relax. No other single product gives you the complete compressed data protection of Norton Utilities® 7.0.

It's the only utility specifically designed to recover data from DOS 6.0 DoubleSpace, Stacker and SuperStor compressed drives. Only with our Speed Disk® feature can you truly defragment the drives, making your recovery a fast, painless process.

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You can't put a price on peace of mind. But we'll try. Take advantage of the offer below and discover the ultimate security of Norton Utilities 7.0. It just might get you out of a tight spot.

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Purchase DOS 6.0 and receive Norton Utilities 7.0 for only $99.00. Look for specially marked packages at your local dealer, or order direct by calling 1-800-453-1062 ext. AP95. Users of any previous version of Norton Utilities can **upgrade to 7.0 for only $49.00** by calling the toll-free number above.***

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CIRCLE 344 ON READER SERVICE CARD

Take a Letter, Computer

Speech recognition is coming of age.

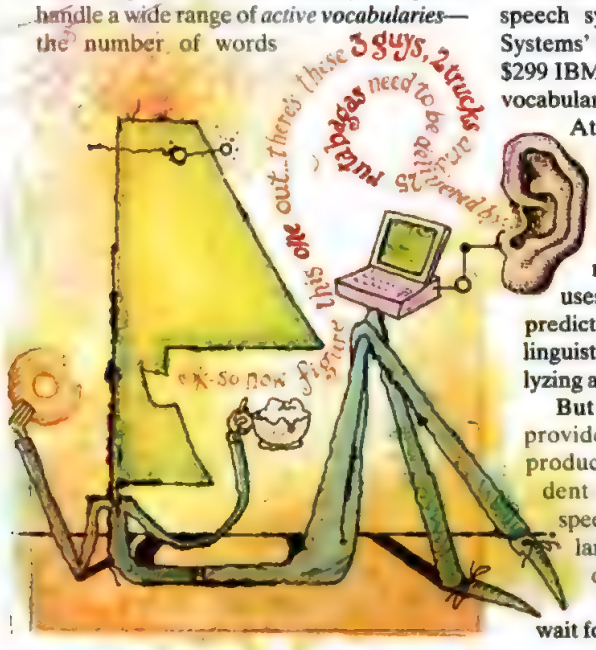
For more than two decades, researchers have been trying to teach computers to recognize spoken words. Their efforts have finally started to pay off in products that let you navigate through Microsoft Windows or that let you dictate documents—if you speak in a stilted fashion or if you use a limited vocabulary. But there's much more to come. By the end of the decade, speech recognition systems will let you speak naturally with a virtually limitless vocabulary.

Today's recognition systems make a number of trade-offs. Some can handle *continuous speech*—the way you speak naturally—but they're expensive and processor-intensive. Most recognize only *discrete speech*—you have to pause after each word (which makes it easier to tell where one word stops and another starts). They can handle a wide range of *active vocabularies*—the number of words they can recognize (anywhere from 30 to 30,000). Some systems use a *grammar*—a set of tables that predefine the words allowed in a given context. Some systems are *speaker dependent* (they adjust to your pronunciations), while others are *speaker independent* (lots of pronunciations).

At the low end, "navigational" products such as Dragon Systems' Voice Pilot in Microsoft's $289 Windows Sound System and IBM's $129 Voice Type Control for Windows have active vocabularies under 100 words. In the middle are continuous-speech systems, such as Verbex Voice Systems' $695 Listen for Windows and the $299 IBM Continuous Speech Series, with vocabularies of 1,000 words or less.

At the high end, the IBM Speech Server Series, a discrete-speech system that requires a RISC System/6000 and is priced between $4,395 and $9,545, can recognize up to 32,000 words. It uses the last two words you spoke to predict the next one. The statistics-based linguistic model was developed after analyzing a text of 550 million words.

But the most useful system would provide the best features from all these products. It would be speaker-independent and could handle continuous speech with a very large active vocabulary. Researchers agree that this type of system is achievable in the next five to seven years. We intend to wait for it.—*Mary Kathleen Flynn*



Illustrations by David Povilaitis

Feelin' Groovy

A NEW INEXPENSIVE MANUFACturing technology developed by Sony Corp. should increase the capacity of magnetic hard disks. Called Pre-embossed Rigid Magnetic technology, or PERM, the process manufactures grooves in the surface of the disk to allow more tracks per inch (tpi), more tightly spaced together.

Today's 2.5-inch hard disk platters typically contain 3,000 tpi and hold 80MB. Hard disks based on PERM should hold approximately 5,000 tpi and 200MB of data. The grooves, which are used in the mastering of CD-ROM disks, make more precise servo-marks and therefore more precise reading and writing to the disk. The grooves also produce less noise by the magnetic heads, meaning an even narrower track width.

Sony expects to produce 200MB platters within a couple of years. And in the not-too-distant future, the Japanese company hopes PERM will make possible a 2.5-inch disk with a capacity of 1.5 gigabytes—enough capacity to hold Windows NT, Unix, and OS/2 all on the same hard disk.
—*Christopher Barr*

Wired to Wireless

THESE DAYS, MOTOROLA MAY BE best known for its ambitious Iridium plan—the billion-dollar satellite system that will one day connect the whole planet—but the communications giant has now launched another, more down-to-earth strategy for universal data transfer: Mobile Networks Integration technology.

The set of application programming interfaces (APIs) enables easy data transfer between wireless and wireline connections. The goal is to make transfers across different kinds of networks as transparent as phone calls that cross local and long-distance carriers' networks.

A dozen companies have already endorsed Motorola's strategy, including ARDIS, General Magic, and RAM Mobile Data. Products that use the APIs are expected this fall.—*Mary Kathleen Flynn*

Pipeline *By Robin Raskin*

Packaging May Be Everything

It's early in the season for year-end predictions, but indulge me for a moment. I expect this to be the season of Designer PCs. What's under the PC's hood will become less important than its packaging. The packaging will be a bundling of sensible components geared toward getting a specific job done.

The early harbingers are everywhere. Dell Computer recently announced a packaging agreement with Adobe Systems and SuperMac Technology. Called the Power Publishing Workstation ($6,699), the Dell machine is a 433ME (486 EISA at 33 MHz) with 16MB of RAM and a 230MB hard disk. A higher-end PowerStation is based on a 466ME ($8,899). Along with Microsoft Windows 3.1, Adobe supplies Photoshop 2.5 and Illustrator 4.0, 200 Adobe fonts, Adobe Streamline, Type Manager, and TypeAlign. Users get to choose between including Aldus PageMaker or QuarkXpress. SuperMac (a case of poor PC namesmanship if ever there was one) bundles the Spectrum/24 true-color graphics board. The Spectrum/24 provides full 24-bit graphics, resolutions of up to 1,152 by 910 pixels, and support for Kodak's Photo CD. The high-end PowerStation uses SuperMac's Thunder/24 board, which adds on-board color calibration and an external color calibrator.

It's a marriage of marketing. There's nothing groundbreaking or even integrated about the design. Still, the packaging is alluring. Graphics illustrators who buy Adobe Photoshop want a 24-bit board, whether they know it or not. They can take comfort in knowing that a machine was pieced together with their needs in mind.

There are others. TriStar, with fast machines, high-end monitors and graphics boards, and good support, earns its reputation as the CAD designer's machine. Tandy offers attractive multimedia PC bundles with sound, CD-ROM, and a user-friendly shell. IBM eyes the multimedia creator with the integrated DVI in its Ultimedia Machine. Josten's Learning Corporation, one of the largest suppliers of educational software, has been innovative in offering low-cost, networked multimedia solutions. The company uses off-the-shelf PCs (Apple, Dell, IBM, and Tandy) for both client and server configurations. The clients include a custom multipurpose card that integrates DVI, audio, VGA, and an Ethernet connection. The system comes with a collection of educational software from Josten. A school can become state-of-the-art with a single phone call. It's rumored that other big mail-order PC companies will include home and educational PCs in their fall lineups.

Imagine the possibilites as the trend takes hold. There'll be the CPA PC—replete with a spreadsheet, a financial on-line service, low-cost accounting, and tax software. There'll be the Medical Worker's PC—a good database linked to a forms package and a CD-ROM full of desk references. The Legal version would definitely include Nexus and Lexis, WordPerfect Office, and a slew of macros to automate form letters.

And for journalists like me, we expect a really good word processor, a few writers' tools, seven e-mail packages, and five PIMs, please.

Robin Raskin is an executive editor of PC Magazine.

Multimedia PC Gets Updated

FROM THE MOMENT THE MULTIMEDIA PC Marketing Council announced its minimum requirements for the Multimedia PC, critics condemned the base-level machine as not powerful enough for meaningful multimedia, and onlookers hoped the Council would smarten up and release a Level 2 spec. Two years later, the Council has dramatically beefed up the requirements for a Level 2 enhanced Multimedia PC.

In the Level 2 MPC specification, the basic machine has been upgraded from a 16-MHz 386SX to a 25-MHz 486SX. The biggest boost is in hard disk space: The initial spec called for a paltry 30MB; Level 2 calls for a healthy 160MB. Memory is also up, from 2MB to 4MB, although the Council is recommending 8MB.

Other dramatic changes come in the CD-ROM drive specification. The original basic MPC required a drive capable of a 150-kilobyte-per-second data-transfer rate. But in keeping with today's CD-ROM drives, the Level 2 spec demands double-speed capability for a 300-KBps data-transfer rate. The CD-ROM drive must also be able to read multisession recordings. And it must be CD-ROM XA (eXtended Architecture)–ready—meaning it has to be able to read XA files, such as those produced by Kodak's Photo CD. The Council also recommends support for XA sound (expected shortly in Photo CD) but doesn't require it, because inexpensive software upgrades for XA sound are due soon, according to Glenn Ochsenreiter, managing director of the MPC Marketing Council.

Other enhancements include 16-bit sound (instead of 8-bit) and support for 65,536 colors in 640- by 480-pixel (standard VGA) mode (up from 16 colors). And for motion video, the Council recommends the ability to paint the screen at 1.2 megapixels per second with 40 percent CPU utilization, in order to display video clips at 320 by 240 pixels with 256 colors at 15 frames per second. According to Ochsenreiter, this is not a requirement because it is difficult to measure.

Level 2 does not replace the original spec; it will have its own logo. But the Council is changing both the MPC and MPC Level 2 logos from trademarks to certifications. It is distributing a suite of tests for licensees to qualify their products, subject to the Council's verification of test results. Ochsenreiter expects products bearing the logo to show up by summer's end. Finally, IBM, which was loudly critical of the original MPC spec, is becoming a licensee.

—Mary Kathleen Flynn

MPC Specs

	Level 1	Level 2
Minimum CPU	386SX-16	486SX-25
RAM	2MB	4MB (8MB recommended)
Hard disk	30MB	160MB
CD-ROM drive	150 K/second transfer rate	300 K/second transfer rate, double-speed support, CD-ROM XA–ready, multisession-capable
Sound	8-bit	16-bit

NT Notebooks

IT LOOKS LIKE WINDOWS NT WILL be pretty popular with the RISC crowd. Microsoft's new 32-bit operating system will be ported to run on a number of RISC processor technologies in addition to Intel's *x*86 architecture.

The reason RISC chip makers are jumping on the NT bandwagon is twofold: they think NT just may gain a significant share of the market, and they feel that NT running on a RISC chip will loosen Intel's stranglehold on Windows machines. Besides, with all the RISC-based Unix operating systems being ported to the Intel *x*86 architecture, turnabout is fair play. Already Solaris and NeXTStep have been announced for Intel, and others are in the works.

NT will be ported to the MIPS R4000 architecture and to Digital Equipment Corp.'s 150-MHz screamer, called the Alpha. Digital, MIPS, and Intel have all launched campaigns to get NT machines based on the new chips to the market as quickly as possible. Their strategies for supporting system vendors include support chips, design blueprints, and design centers. In addition to these announced hardware platforms, NT is also expected to be on Hewlett-Packard's PA-RISC chip and even on Apple/IBM/Motorola's PowerPC chip.

While DEC eventually hopes to sell its Alpha chips to other systems vendors, several PC makers have already committed to using the MIPS R4000 or R4400. And now there's even a MIPS chip designated to run NT on a notebook. Called the R4200, it's a RISC chip that will run at 40/80 MHz (externally and internally). It has power management features that allow it to save battery juice, and will come in a 3.3-volt version.

RISC-powered notebooks aren't new, but they are rare. Notebooks based on the Sun Sparc microprocessor and clones have been around for years, but haven't sold well due to their limited graphics, large size, and hernia-inducing weight. Notebooks based on the MIPS R4200 should be priced comparably with today's high-end color notebooks, with the first units available early next year.

—Christopher Barr

Top Retail Software

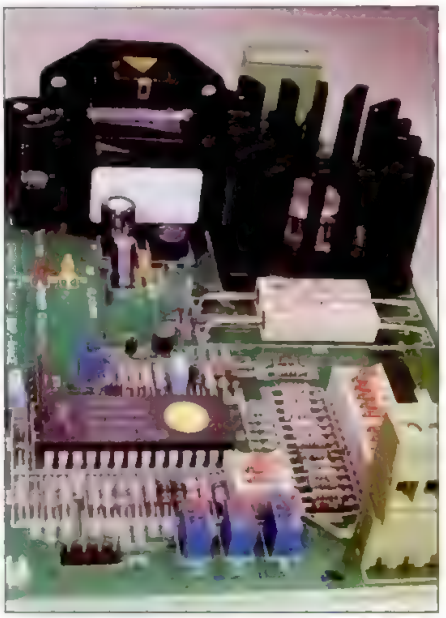
Current ranking	Last issue	Product company
1	1	**MS-DOS 6.0 Upgrade Kit** *Microsoft Corp.*
2	3	**Microsoft Windows 3.1** *Microsoft Corp.*
3	10	**QEMM-386 6.0** *Quarterdeck Office Systems*
4	—	**ClarisWorks for Windows** *Claris Corp.*
5	—	**Filemaker Pro for Windows 2.0** *Claris Corp.*
6	—	**Money for Windows 2.0** *Microsoft Corp.*
7	7	**Quicken 2.0 for Windows** *Intuit*
8	—	**LapLink V** *Traveling Software*
9	11	**Quicken 6.0** *Intuit*
10	6	**Microsoft Office for Windows 3.0** *Quarterdeck Office Systems*
11	12	**Excel for Windows 4.0 Upgrade 3.0** *Microsoft Corp.*
12	—	**WordPerfect 5.1** *WordPerfect Corp.*
13	—	**Access for Windows 1.0** *Microsoft Corp.*
14	—	**Paradox for Windows 1.0** *Borland International*
15	—	**Quattro Pro for Windows 1.0** *Borland International*

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending May 9, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

15-Minute Recharge

THANKS TO FAST-CHARGE TECHnologies from system makers such as Compaq Computer Corp., today's portable PC owners can recharge their batteries in almost an hour. Now, a new chip set developed by Enstore Energy, a research and development firm based in Graz, Austria, promises to let you recharge an empty battery in as little as a quarter of an hour. Though charging times will vary with the battery used, Enstore says its technology extends to nickel cadmium and nickel hydride batteries, as well as lead/acid power cells.

According to Enstore project manager Herwig Lisec, the ECS-II-IC chip constantly reads the electrochemical level of the battery. It then acts as a communications conduit between the power cell and the charging mechanism, enabling the battery, not the charger, to determine electric current levels. Not only will this technology increase charging times, Enstore claims it will also decrease *dis*charging to as little as 15 to 30 minutes, increase battery capacity (up to 110 percent), extend overall battery life, and even stop battery "memory" (a disputed phenomenon in which a nickel cadmium battery refuses to recharge to full capacity after repeated use).



Enstore Energy's chip set will let you recharge an empty battery in 15 mintues.

Enstore has done most of its testing with nickel cadmium, but the company says preliminary results show that lithium batteries can be charged in as little as 3 minutes—compared with 48 hours normally—and last twice as long. Lead/acid also double their useful life, while Zinc batteries last three times as long, says Enstore.

The company plans to market the product both as an end-user package (for laboratory or other industrial uses) and as a micro chip set for use in portable computer AC adapters and systems, as well as other consumer electronics products such as video camcorders. Enstore's chips are presently being used inside Austrian police radios and have also been bought by Mitsubishi.

You can purchase an evaluation board for $350 now, and the product sells for anywhere from $25 in low quantities down to $6.50 in higher quantities. Enstor, which will also negotiate custom implementations, is distributed in the U.S. by EnChip of E. Hanover, New Jersey (201-328-2049).

—Oliver Rist

Photography by Thom O'Connor

Briefs

QMS EXPECTS TO BE THE FIRST TO DELIVER a desktop color laser printer. Shipping this summer, the $12,499 QMS ColorScript Laser 1000 Print System will also be the first to use an organic photoconductor belt that processes each color plane while transferring it to a drum, which then transfers the four-color image to paper in a single pass.

TO IMPROVE SUPPORT AND SERVICE IN THE PC industry, a group called abcd: The Microcomputer Industry Association has initiated the A+ Certification Program, the first independent testing and certification program for service technicians.

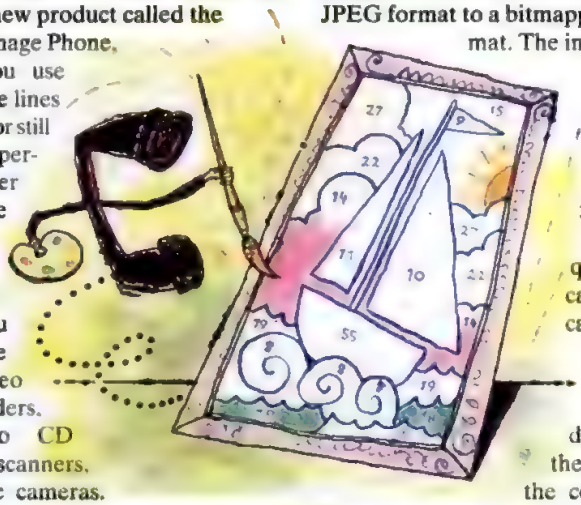
CD-ROM DISKS ARE CHANGING SOFTWARE distribution dramatically. To make sure the retail channel doesn't get left out, Ingram Micro, the world's largest wholesale distributor of PC products, will distribute CD-Access, a free disk with 100 to 200 demonstrations and encrypted applications on it, to resellers. Other companies using CD-ROM disks to distribute apps include Apple and TestDrive Corp.

WITH SUPPORT FROM APPLE, AT&T, DIGITAL Equipment Corp., Hewlett-Packard, IBM, and Xerox, the American Plastics Council's Computers & Business Equipment Group has launched a program to investigate the reclamation of plastics from computers and other equipment. The group will develop a design guide for manufacturers based on its research.

AMID GROWING CONCERNS THAT ELECTRONIC devices may interfere with in-flight navigation and communications systems, American Airlines recently banned the use of laptops on takeoff and landing.
—Mary Kathleen Flynn

Talking Pictures

YOU WON'T HAVE TO WAIT FOR Integrated Services Digital Network (IDSN) to come to your neighborhood before you can get some of its promised voice- and data-merging capabilities. AT&T, which sells the VideoPhone, has introduced a new product called the Picasso Still-Image Phone, which lets you use standard phone lines to send full-color still images to the person at the other end of the same line while you talk.



The $3,300 Picasso lets you capture the images on video cassette recorders, Kodak Photo CD players, PCs, scanners, and electronic cameras. You can display them on computer monitors and televisions. Except for a brief initialization period, you can talk the whole time you're sending or receiving the images. You can even annotate them using a mouse. And the calls won't cost you any more than a regular telephone call.

Up to 32 images can be stored on the Picasso telephone. Using the optional Windows-based interface software, which had not been named or priced at press time, you can store an unlimited number of images on your PC's hard disk or floppy disk. Picasso comes with a standard serial port for exchanging files with personal computers. Images are converted from a compressed JPEG format to a bitmapped graphics format. The interface software is expected to be available this fall; Apple Macintosh support is planned for next year.

Despite the quite impressive capabilities of Picasso, AT&T is not marketing the device as a "horizontal" product to be sold to the masses. Instead, the company expects Picasso to appeal to vertical markets—such as retail stores, insurance firms, convention centers, and hotels—where there is a need for people at disparate sites to share and collaborate on images.
—Mary Kathleen Flynn

Infra-Red Communications

ONE OF THE WIRELESS TECHNOLOgies overlooked by the megababble over spread-spectrum radio frequency (RF) has been infra-red (IR). Using a range of light that is not visible to the human eye to transmit data, IR has been around for decades. It's used in mice and can probably be found in your home TV's remote-control unit.

IR may soon make the jump to your PC, as Hewlett-Packard is migrating IR technology from its calculators to its portables and desktops. Already you can squirt data from one 95LX and 100LX palmtop to another using IR, and soon you'll be able to send it to the new OmniBook and Vectra 486XM desktop series.

This is different from the diffuse IR network technology being developed by Photonics to allow you to walk around and keep a wireless network connection. HP's IR technology is line-of-sight, to let you do wireless file transfers to another computer, as well as to printers and other peripherals such as modems.

The data stream is serialized, so it looks to your application as it would coming through a comm port via a communications program or serial printer. Like a communications program, the first versions will use XMODEM or Kermit as the error-correction protocol and work at speeds up to 115 kilobits per second. Future versions are expected to get the data rate up to 1 megabit per second.

Traveling Software has adapted its Universal Communications Object, which is used in LapLink, to operate under IR, and Hewlett Packard is using Connexus of Warm Springs, California, to organize an IR standard and to license the HP-IR technology. According to HP, more than 30 companies are evaluating HP's IR technology. Both Tandy and Apple will have IR in their (respective) Zoomer and Newton handheld devices, but do not currently plan to use the HP standard protocol.
—Christopher Barr

TRENDS PLUS

You can go on-line to discuss Trends articles and story ideas with *PC Magazine* editors Christopher Barr, Mary Kathleen Flynn, and Robin Raskin in the Trends section of PC MagNet's Editorial Forum. Type GO ZNT:EDITOR from any CompuServe prompt.

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$1995	$55	$72
$2095	$58	$76
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$2295	$64	$83
$2395	$67	$87
$2495	$69	$90
$2595	$72	$94
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$2795	$78	$101
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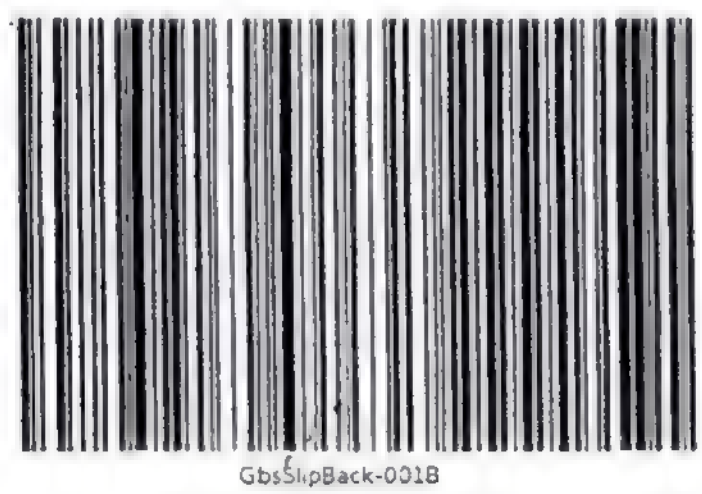
Z-Card payments based on 1/36 of system price, minimum payment $30. Monthly interest excluded. Lease payments based on a 36-month lease, 10% purchase option.

Inverted Back

1. Follow instructions on the other side



Back

1. Follow instructions on the other side

Folded edge of the page

Inverted Foldout slip-sheet

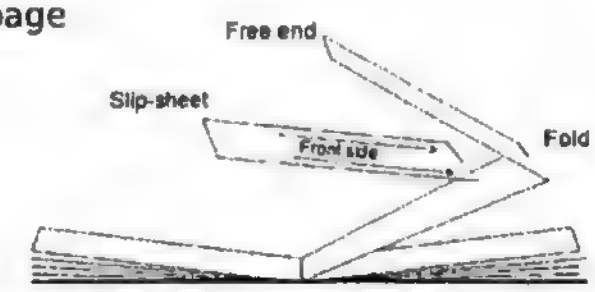
1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

GbsSlipSheet-001

Folded edge of the page

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Congratulations! If you answered *Yes* to at least half the questions you're a bona fide *Computer Genius.* You know that there are *real and meaningful* differences between ZEOS systems and those offered by the others.

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SYSTEM HIGHLIGHTS	PACKAGE 1	PACKAGE 2	PACKAGE 3	PACKAGE 4	AND ALSO
	■ ZIF socket upgradability to Pentium OverDrive CPU ■ 2MB high-speed RAM ■ 107MB local bus IDE hard drive with 32K cache ■ Windows accelerated VL local bus video with 1MB RAM ■ Crisp 14" ZEOS color SVGA .28 NI monitor ■ Your choice of floppy drives ■ MS DOS 6.0 plus Enhanced Tools	■ ZIF socket upgradability to Pentium OverDrive CPU ■ 4MB high-speed RAM ■ 214MB local bus IDE hard drive with 128K cache ■ Windows accelerated VL local bus video with 1MB RAM ■ Crisp 14" ZEOS color SVGA .28 NI monitor ■ Both 1.2MB and 1.44MB floppy drives ■ MS DOS 6.0, Tools, plus Windows & Mouse, plus Lotus Organizer *and* your choice of Lotus Windows applications	■ ZIF socket upgradability to Pentium OverDrive CPU ■ 8MB high-speed RAM ■ 340MB, 13ms local bus IDE hard drive with 128K cache ■ Windows accelerated VL local bus video with 1MB RAM ■ Crisp 14" ZEOS color SVGA .28 NI monitor ■ Both 1.2MB and 1.44MB floppy drives ■ MS DOS 6.0, Tools, plus Windows & Mouse, plus Lotus Organizer *and* your choice of Lotus Windows applications	■ ZIF socket upgradability to Pentium OverDrive CPU ■ 16MB high-speed RAM ■ 452MB, 12ms local bus IDE hard drive with 256K cache ■ Windows accelerated VL local bus video with 1MB RAM ■ Crisp 14" ZEOS color SVGA .28 NI monitor ■ Both 1.2MB and 1.44MB floppy drives ■ MS DOS 6.0, Tools, plus Windows & Mouse, plus Lotus Organizer *and* your choice of Lotus Windows applications	■ Upgr Over CPU ■ *Flas.* upgr ■ *Eigh* inclu VES. ■ Two relial
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486DX2-50	**$1895**	**$2195**	**$2495**	**$2895**	
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☑ Yes ☐ No

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Please answer YES or NO to each of these Questions:

☐ Yes ☐ No Do you want a system that runs Windows *so fast* it "blows all competitors away—in some cases performing more than ten times as fast as competitors" *(PC Magazine)*...?

☐ Yes ☐ No Would you like to have incredible VL-Local Bus performance—not only in video, but also in a hard drive interface that moves your data up to *125% faster* than regular IDE interfaces?

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☐ Yes ☐ No Should your computer have built-in reliability like *two cooling fans*—which are increasingly important given the higher-performance CPUs of today and tomorrow?

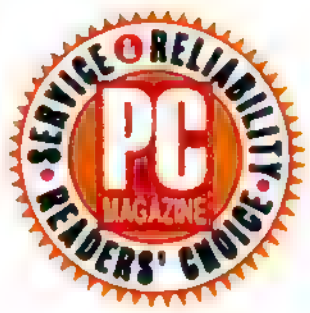
SCORE BIG

☐ Yes ☐ No Is surge suppression important to you, and shouldn't it be built right in so you don't have to worry about it?

☐ Yes ☐ No Do these reviewer comments sound good to you? *"A fast, beautifully designed PC with an upgrade path that just won't quit" (PC World) "An array of features to make a user's mouth water" (PC Magazine) "[this system] grabs Windows by the throat and flings it across the screen" (PC Sources) . . . ?*

Prove it to Yourself.

☐ Yes ☐ No Would you like to buy from a company that recently received *PC Magazine's* Readers' Choice award for outstanding Service and Reliability—for both desktop and laptop systems?



☐ Yes ☐ No Even though most vendors offer only part-time technical support, do you deserve to get toll-free help *whenever* you need it 24 hours a day, 365 days a year?

☐ Yes ☐ No How about safety? Is it important that your *entire* system (not just the power supply) passes the rigorous tests necessary to obtain the UL® Listing?

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So my boss comes in and says to me we need to order some computers some desktops for the new division and a coupla new notebooks for the three new hires in sales and we need them yesterday which is generally the way things function in my job so I say no problem like I usually do and meanwhile I'm thinking about how the *hell* heck I'm gonna pull this one off perhaps I'm better off in a career scooping ice cream at least it'd be less stressful so I start by calling one big computer company but they say it'd be about a five week lead time and I say I don't even get a five hour lead time so for good measure I try another computer company and after seven tries I'm still getting a busy signal so on to yet another computer company knowing full well my boss'd never go for them because they don't have 24 hour tech support they quote me a 3 week lead time which is a little better but it's still not enough to save me and then I remember reading about ZEOS's Computers Now℠ program that offers same-day shipping on many popular configurations and I also remember my boss has a ZEOS Notebook that he covets so I think what the hey let's give it a shot and lo and behold ZEOS can do it their new local bus upgradables are ready to go their hot new Contenda is ready to go and because I called them before 1 p.m. Central and my credit is approved they are going to ship it out to me today today today so I load up on a coupla desktops and three new notebooks for the folks in sales and zing bam they're on their way and I think this job isn't quite so bad after all so I kick back and wait for the next crisis to hit and while I'm sitting there I make a special note in my rolodex to call ZEOS at **800-554-7172** for

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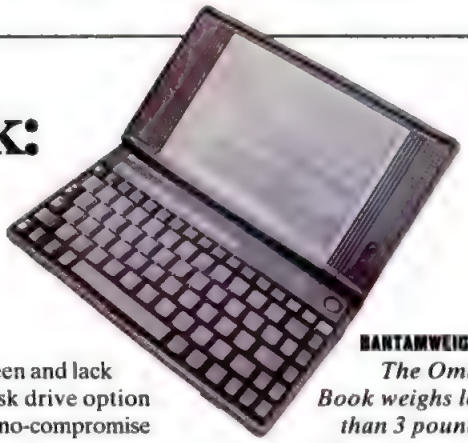
First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

■ Notebook PCs

HP's OmniBook: The Ultimate Subnotebook?



BANTAMWEIGHT: *The OmniBook weighs less than 3 pounds.*

BY JOHN R. QUAIN

Subnotebook PCs usually involve tradeoffs. You get a small, light, portable machine, but the keyboard is usually cramped, the pointing device awkward, and the numerous accessories onerous. And then the battery dies.

Hewlett-Packard Co.'s innovative OmniBook 300, a sturdily constructed subnotebook with a full-size keyboard, an adroit built-in mouse, and the ability to run on four AA batteries, solves many of these problems, though its reflective screen and lack of any floppy disk drive option take it out of the no-compromise category.

Weighing just 2.9 pounds and measuring a mere 1.4 by 11.1 by 6.4 inches (HWD), the $1,950 OmniBook includes a 20-MHz AMD 386SXLV CPU; a 40MB PCMCIA 2.0 Type III hard disk; 2MB of RAM; one parallel and two serial ports; a rechargeable battery; an AC power adapter; parallel cable; and a full suite of ROM-based Windows, Version 3.1, software. The OmniBook can also accommodate more expensive flash memory cards, and the preliminary model we examined came equipped with a 10MB PCMCIA 2.0 Type II flash memory card option (there was no hard disk) for $2,375. Additional expansion and storage are handled by two more PCMCIA Type II slots, but there is no 3.5-inch floppy disk option.

One of the OmniBook's many impressive features is that it can run on four standard AA batteries.

No more searching for free wall sockets in airports or toting around heavy rechargeable batteries. Just pick up additional batteries at the local convenience store when the old set dies.

If you do use the rechargeable nickel hydride batteries, you'll be able to work through almost an entire day without fearing "low power" beeps. Also included is a sleep-and-resume feature. With its 3.3-volt AMD 386SXLV CPU, the system is rated for up to 9 hours using the

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■ Laser Printers

New Lexmark Lasers Look For a Place on the LAN

UP ON THE LAN: *The verticality of the 4039 16L is a hallmark of Lexmark design.*

BY ALFRED POOR

Just 18 months after the introduction of its family of LaserPrinter 4029 600-dot-per-inch printers, Lexmark is back with a whole new series of printers: the 4039 LaserPrinters. Continuing Lexmark's tradition for small footprint, high-performance printers, the 4039 line includes five models, from the $1,599 10-page-per-minute 4039 10R all the way up to the model we tested, the 4039 16L network printer.

The three printers in between those two extremes each take aim at a different price/performance target. The 10-page-per-minute Model 10R Duplex bundles in a snap-on duplexer for two-sided printing. Its $2,199 price tag makes it a relatively inexpensive solution for two-sided printing.

The Model 12R has a 12-page-per-minute print engine and includes 4MB of memory on-board at a total price of $1,999.

Lexmark's lowest-cost LAN-specific printer is the Model 12L, which has a 50,000-page-per-month duty cycle and 500-sheet input and output trays. It's priced at $2,899.

THE 4039 16L

Designed to compete with similar offerings from Hewlett-Packard, QMS, and Compaq, the 4039 16L is driven by a print engine rated at 16 pages per minute at 300 dpi, but only 8 ppm at 600 dpi. The unit carries a list price of $3,399, which is less than the Hewlett-Packard HP LaserJet 4Si's $3,749 base price, and includes PostScript compatibility along with PCL 5 support (the 4Si base model supports only PCL 5). Lexmark has clearly made an effort to put together

Continues on page 39

OmniBook

CONTINUED FROM PAGE 37

flash memory card or up to 5 hours in systems with hard disks. Under continuous use with the flash memory option, the OmniBook 300 lasted a remarkable 7 hours 12 minutes on PC Magazine Labs' Battery Rundown test.

The OmniBook 300 doesn't include complicated power-saving controls, but battery life can be extended by setting the system to power down after 1 to 60 minutes of inactivity. To restart, simply push the on/off button and the OmniBook returns you to where you left off.

Interestingly, HP has put Windows 3.1 and DOS, Version 5.0, on a ROM card—a first for a subnotebook maker. The standard OmniBook 300 ROM software also includes Microsoft Word for Windows, Version 2.0; Microsoft Excel, Version 4.0; and the same HP PIM (personal information manager) utilities featured with the HP 100LX palmtop: Appointment Book, Phone Book, and Financial Calculator. Traveling Software's LapLink Remote Access is also included so that you can more easily connect the OmniBook to a desktop, network, or other portable computer.

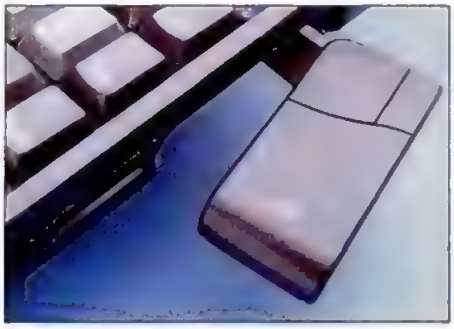
In general, the software packages installed on the system are the full-service versions. DOS fans, however, will notice that some elements, including DOS Shell, Editor, and Q-Basic, are missing. You can download them, free, from HP's HPOmni forum on CompuServe. On the other hand, this version of DOS 5.0 features some enhancements; specifically, DOS 6.0's DoubleSpace data-compression utility. It's preinstalled and nearly doubles the capacity of the unit's flash memory and hard disk to 20MB and 80MB, respectively. Since most of the storage-hungry software resides in ROM, this should be ample room for most users.

FIRST LOOKS PLUS

From July 5 to July 9, you can go online on PC MagNet to discuss the HP OmniBook with First Looks editor Don Willmott, HP OmniBook product manager Roy Breslawski, and HP technical support manager David Horn. Type GO ZNT:EXEC from any CompuServe prompt.

MIGHTY MINIMOUSE

To make the ROM-based Windows software easy to navigate, the OmniBook includes a responsive, full-size keyboard and a unique, built-in mouse. At the touch of a button, the miniature mouse slides out of an opening on the top right side of the unit. Shaped like a cigarette lighter and tethered to the PC by a flexible plastic strip, the two-button mouse behaves pretty much like the standard desktop animal, except that it has no ball underneath. The flying mouse controls the cursor via the connecting cable's position, and the plastic umbilical cord is rigid enough to let you maneuver the mouse even when no tabletop is available. It's the best pointing device solution that we've seen in a portable PC.



FLYING MOUSE: *The OmniBook's minimouse requires no desktop contact.*

The penalty that you pay for ease of use is a decrease in flexibility, and the OmniBook 300 still has some shortcomings.

Foremost among them is its LCD (liquid crystal display) screen. Though the OmniBook's screen is a full-size monochrome VGA display, its use of reflective passive-matrix technology is a disappointment. In well-lit offices, the screen is clear enough, but you may need to squint under dim office or airplane lights. Unfortunately, there is no contrast control; only two brightness-adjustment buttons are available.

Furthermore, we couldn't conduct our standard suite of processor and memory tests on this product because of its potentially problematic conventional-memory restrictions. Due to Double Space's cache and an execute-in-place file, only 474K of memory below the 640K mark is free, which wasn't enough to run our Hardware Benchmark Tests, Release 7.01. Although few users will run into these types of memory difficulties—particularly since key programs are preloaded on the OmniBook—the reduced amount of available conventional memory may prove a hindrance for some tasks, such as loading network drivers with DOS programs such as Lotus 1-2-3.

NO COMPROMISE: *The keyboard is the largest of any subnotebook.*

The lack of any floppy disk drive option will also annoy some users, but at least HP included LapLink and a parallel cable to ease the problem. There's also a built-in infrared (IR) serial port. Operating like a VCR's remote control (and the IR ports on the 95LX and 100LX palmtops), this feature lets the OmniBook communicate with HP's new line of desktop Vectra 486XM machines, which are equipped with IR serial ports. No cables, no hassles. Currently, HP is the only PC vendor with such desktop machines, but it's working on an IR standard with several other companies.

To complete the package, a user-installable 2,400-bps modem with 9,600-bps faxing is available for $379. The modem comes with Microsoft Mail Remote, Version 3.2, to access e-mail systems; Delrina Technology's WinFax Lite for fax delivery; and FutureSoft Engine-ering's DynaComm for Windows for standard terminal emulations.

The hard disk model of the OmniBook is expected to have a street price of about $1,700. Even though faster Intel 486SLC subnotebooks exist in this price range, the competitors typically weigh a full pound more and offer half the battery life of HP's model. Some of the OmniBook's features appear in other notebook PCs, but no other portable combines it all in such a lightweight package. □

FACT FILE

HP OmniBook 300

Hewlett-Packard Co., 1000 N.E. Circle Blvd., Corvallis, OR 97330; 800-443-1254; 503-757-2004.

List price: With 40MB hard disk, $1,950; with 10MB flash memory (no hard disk) $2,375.

Options: 2MB RAM, $179; 5MB flash memory card, $499; 10MB flash memory card, $879.

In short: This 2.9-pound subnotebook can run on four AA batteries and lasts more than 7 hours in battery rundown tests. Computing travelers also will be impressed by the OmniBook 300's built-in flying mouse and full-sized keyboard.

421 ON READER SERVICE CARD

Lexmark

CONTINUED FROM PAGE 37

an aggressive combination of performance, features, and price.

From the outside, the 4039 16L looks like a Lexmark printer; the vertical stacking of paper tray, print engine, and output bin gives the printer its familiar small footprint of about 15 by 21 inches. The paper tray and the face-down output bin each hold a full ream (500 sheets) of paper. The front panel has easy to use controls and a four-line, 20-character-per-line LCD message window.

ONE-PIECE CARTRIDGE

The 4039 16L uses one-piece cartridges for drum, developer, and toner, but you won't have to change them often. The special high-capacity cartridges are rated at 12,800 pages (with 5 percent coverage). Lexmark has a recycling program for used cartridges.

The printer is designed for the heavier loads of shared use, with a duty cycle rating of 75,000 pages per month. The engine can print at 600 dpi and includes Lexmark's version of resolution enhancement, Print Quality Enhancement Technology (PQET.) It also has a new PictureGrade feature designed to improve halftone images, with the ability to create up to 100 levels of gray-scale tones.

UPGRADABLE

The printer's "personality" comes on a SIMM, which can be easily changed by the end user. This feature will make it possible for owners to upgrade their machines quickly—and presumably at reasonable cost—whenever Lexmark makes improvements to the machines. The controller is powered by an AMD RISC processor running at 20 MHz, and advanced memory management techniques make it possible for the printer to work well with its standard 4MB of memory. RAM is expandable up to 16MB if you need it. Lexmark also offers 1MB or 2MB of nonvolatile flash memory, which can be installed to retain downloaded fonts, forms, or other macros.

OUTPUT: *The 4039 16L includes PostScript and PCL 5 compatibility. Print quality is excellent, but speed drops to 7.0 ppm at 600 dpi.*

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Bold *Italic* Compre

NETWORK INTERFACE ACCEPTED

The 4039 16L comes with parallel and serial connectors, which are neatly concealed behind a swinging hatch in the back of the printer. The printer also accepts network interface cards, and you can choose from Ethernet, LocalTalk, and Token-Ring options.

Other options include additional paper-handling features, such as a second paper bin, an envelope feeder, and a duplex printing option to print on both sides of a piece of paper. We tested the duplex option (list price $699) and found it to be easy to install and operate, making it an attractive choice to reduce paper consumption.

SPEED TESTS

In our tests, we found that the printer performed well for its intended missions. It passed the PCL compatibility tests, though it doesn't support the highest levels of image compression offered by the HP LaserJet 4 series. It managed 13.6 ppm on the PCL text speed test, and 4.4 graphics pages per minute on the PCL graphics test. The printer is compatible with PostScript Level 1 and can automatically switch language modes based on the incoming print job. It managed 0.62 graphics pages per minute for the 600-dpi PostScript image, which is a little slow for a product in this class. The print resolution setting showed a major impact on PostScript print speed, as predicted by the machine's rated speed; the 300-dpi result was 13.2 ppm, but it dropped to 7.0 ppm at 600 dpi.

With the duplexing option installed and tested under PCL, the printer managed 12.1 ppm, just a page and a half slower per minute than in single-sided printing.

POSTSCRIPT AND PCL

Print quality was excellent with both PostScript and PCL, and with PQET enabled showed significant improvement in smoothing curves and near-vertical or -horizontal lines. Solid-black areas showed even toner coverage and crisp edges.

The 4039 16L comes with far more than the typical owner's manual. A large binder contains sections on setup, installation of all available options, and a comprehensive operations manual. In addition, there are three large, spiral bound books: Software Application/Driver Information, Technical Reference, and Service Manual. Combined, these three references provide a wealth of detailed information about the printer and the languages that it supports. The printer also comes with a variety of software drivers, including PCL and PostScript drivers for Windows 3.*x*. Lexmark also backs the printer with a one year on-site warranty.

All this adds up to an impressive printer, but there are some flaws in the total picture. For example, the performance drop for 600-dpi PostScript makes the printer less appealing in a shared scenario and puts it among the horde of 8-ppm desktop lasers. And even at this slower speed, it is only "half" of a 600-dpi printer, supporting PCL 5 only at 300 dpi (unless you use the special Windows driver provided). As a result, it is perhaps best compared with a LaserJet III or IIIsi, rather than a LaserJet 4Si.

If you want a PostScript- and PCL 5–compatible printer with a small footprint and support for network connections, and want to get it at an attractive price, the Lexmark IBM LaserPrinter 4039 16L is a reasonable choice, though it does present some compromises in terms of resolution and print speed when compared with other, more expensive shared printers. □

FACT FILE

IBM LaserPrinter 4039 16L

Lexmark International Inc., 740 New Circle Rd. NW, Lexington, KY 40511; 800-358-5835, 606-232-2000; fax, 606-232-2380

List price: $3,339; duplex option, $699; Ethernet network option, $439.

In short: The small-footprint IBM LaserPrinter 4039 16L makes some performance trade-offs in high-resolution printing, but it's an able competitor in the shared-laser category.

421 ON READER SERVICE CARD

Notebook PCs

IBM Turns Up the Power on The ThinkPad 720C

BY JULIE COHEN

When the notebook PC market first exploded, IBM was conspicuously absent from the scene. The first IBM notebooks were late, heavy, and underpowered. But last year, when the ThinkPad 700 series made its debut, IBM came back into the spotlight with one of the best notebooks available. Now, with the ThinkPad 720C, IBM has improved on an already superb product. A big active-matrix color display, ample hard disk space, and a clock-doubled 486SLC2 processor make this $4,695 unit IBM's most powerful.

DAZZLER: *The 10.4-inch color screen shines.*

IBM made several improvements over the 25-MHz 486SLC-based 700C. Besides the faster CPU, the 7.4-pound unit ships with a removable 160MB hard disk, and can hold one Type III PCMCIA card or two Type II PCMCIA cards. The earlier model had a 120MB hard disk and space for a built-in modem, but no PCMCIA slot. To make this unit easier to use as a desktop replacement, IBM has introduced a port replicator ($75), with serial, parallel, mouse, keyboard, and VGA ports.

With the 486SLC2—IBM's Intel-compatible 16-bit CPU with a 16K cache—IBM boosted the ThinkPad 720C's CPU performance by 50 percent compared with that of the 700C. The system's Graphics Winmark score of 5.29 megapixels per second is 57 percent higher, and the nickel hydride battery lasted about a half hour longer than the earlier model: 4 hours 3 minutes on our ZDigit Rundown test. In general, the ThinkPad 720C's benchmark test scores fall in a range comparable to Intel 25-MHz 486SX-based notebooks tested by *PC Magazine.*

Two features IBM wisely left alone: the breathtaking, 10.4-inch active-matrix Toshiba screen and the Trackpoint II pointing device, which resembles a pink pencil eraser tucked among the G, H, and B keys. Two buttons placed directly below the Spacebar make this device equally convenient for left- and right-handed mousers. It may take some time to acclimate yourself to moving the cursor this way, but it's control and accuracy are very good.

With its stunning color display, the ThinkPad 720C notebook comes as close to being a desktop replacement as you can get today.

• List price: *IBM ThinkPad 720C with 4MB RAM, 160MB hard disk, $4,695. IBM Personal Computer Co., Rte. 100, Box 100, Somers, NY 10589; 800-772-2227, 914-766-1900.*

Circle 423 on reader service card

Memory Management

NetRoom 3.0: More Room at the Top

BY AMARENDRA SINGH

NetRoom, Version 3.0, from Helix Software has evolved into a memory manager that can do far more than move your network drivers out of conventional memory. By significantly improving your PC's memory configuration without customized tweaking, the $99 NetRoom has broken new ground in memory management.

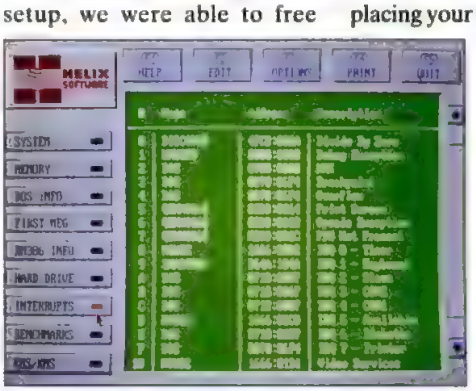
It's no surprise that this upgrade comes on the heels of MS-DOS 6.0. After all, Helix Software codeveloped Memmaker, Microsoft's own memory manager. Although the two programs have similar setup screens, they are very different.

NetRoom is not the first memory manager to load drivers and other memory resident programs into memory above 1MB, but it is the first to implement a new technology called "cloaking." Cloaking frees the upper memory blocks used by the system and video BIOS, replaces them with its own customized BIOS (written by Award Software) that executes in extended memory, and runs them in 32-bit mode. This also enables the system to pull additional drivers out of conventional memory and load them high. Since this doesn't require expanded memory (as QEMM's Stealth does), NetRoom further frees up the 64K block that an expanded memory manager would have used for paging.

The straightforward installation routine gives you three options—conservative, aggressive, and custom—but it does assume a certain amount of PC knowledge, which might be a problem for novice users.

NetRoom performed consistently well in several test setups. Where the configurations were not demanding we were able to free up significant quantities of conventional memory, but not more than we could with other memory managers. Where NetRoom edged out competitors was in complex setups where the memory requirements of various drivers and TSRs exceeded available upper memory.

By using the aggressive setup, we were able to free upper memory as well, allowing us to extract more drivers from conventional memory. When we tested a system compressed with DOS 6's DoubleSpace and loaded with Novell's NetWare Lite, MCI Mail Express, and a mouse driver, we increased available conventional memory from 400K to 616K, while still having 58K of high memory.



DISCOVER: *NetRoom 3.0's graphical look.*

NetRoom also includes a utility called Discover, which displays the content of memory and suggests how resources can be rearranged.

If you're nervous about replacing your existing BIOS, you don't have to enable NetRoom's BIOS cloaking. Even without cloaking, NetRoom will improve your system's memory efficiency enough to justify the purchase.

• List price: *NetRoom, Version 3.0, $99.* Requires: *1MB RAM, 1.5MB hard disk space, DOS 3.3 or later. Helix Software Co., 47-09 30th. St., Long Island City, NY 11101; 800-451-0551, 718-392-3100; fax: 718-392-4212.*

Circle 420 on reader service card

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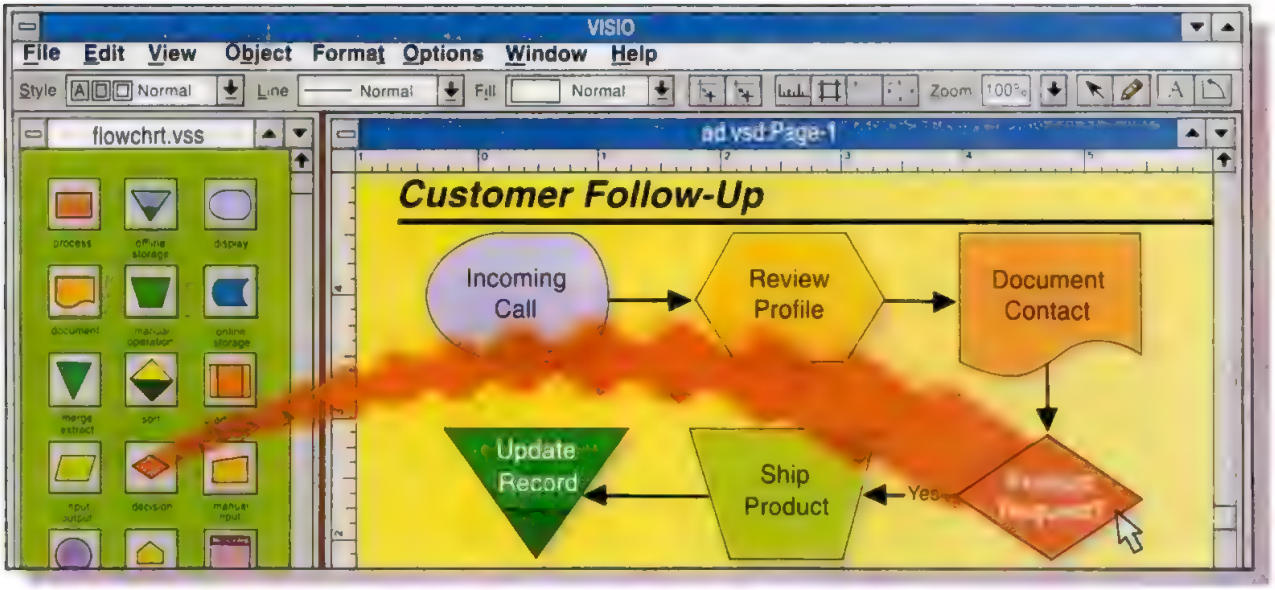

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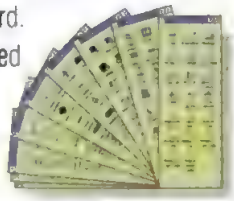
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CIRCLE 243 ON READER SERVICE CARD

■ Windows Programming

Visual Basic 3.0 Supports Wide Database Access, OLE 2.0

BY BARRY SIMON

Only six months after releasing Visual Basic 2.0, Microsoft is ready with a new version of its visual programming environment that's designed to catch the OLE 2.0 wave. By providing hooks to the automation programming part of the OLE 2.0 dynamic link library, Microsoft Visual Basic, Version 3.0 for Windows, now lets you write programs that incorporate other applications such as word processors and spreadsheets. Another big advance is in database access, which is now built into the core VB engine.

You'll also find an outline custom control, a setup wizard, a "most recently used" project list, and a PopUpMenu command that pops up a menu at the mouse position in response to a programmer-specified event.

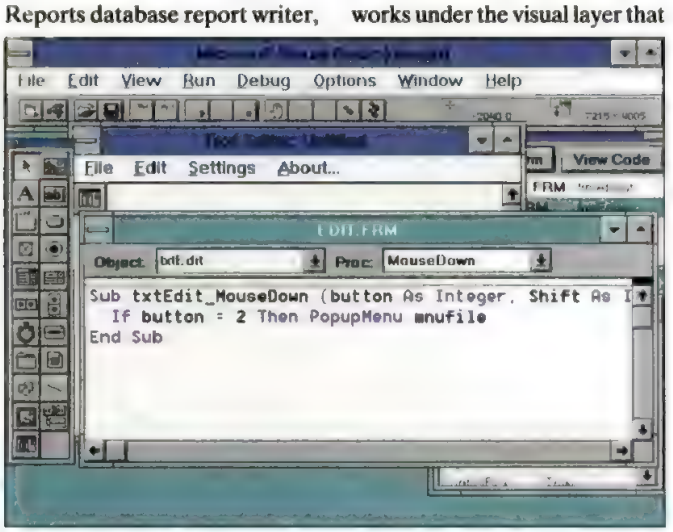
As with VB 2.0, the new version is available in two editions—the $199 Standard Edition for students and casual users, and the $495 Professional Edition, which comes with a special version of the Crystal Reports database report writer, as well as several other advanced tools for developers.

VISUAL DATA ENGINE

Until now, programmers who used VB to design front ends for databases—a common VB application—had to roll their own database access or rely on third-party database custom controls such as Apex Software Corp.'s Agility/VB and Pioneer Software's Q+E Database/VB for Windows. Version 3.0 changes all that.

VB now includes the Microsoft Access engine—the same DLL that's in Microsoft Access, Version 1.1—which you can distribute with your programs. The Access engine lets you create Access databases as well as read and modify Btrieve, dBASE, and Paradox databases. The Professional version offers support for any ODBC format as well, including drivers for Microsoft SQL Server, Oracle, and Sybase SQL Server.

There are two ways that your VB application can get to the Access DLL and then to the data you need. The first method works under the visual layer that relies on the text box, check box, label, picture, and image controls. The second works under a programmatic layer that supports a variety of new data types (such as Database Object, Table Object, and Field Object) and language functions.



POP-UP: *A single line of code adds a pop-up menu to apps.*

you set the data control to allow updates to be made, the user can edit the data from that text box.

OTHER DATA CONTROLS

You can also control database objects at a programmatic level. For example, you can add an index to a table or delete a record. One useful feature lets you set bookmarks in the database and return to them later.

The Professional Version includes language support for a Table Object. Programmers who are more versed in Indexed Sequential Access Method (ISAM) syntax than in SQL syntax will have an easier time using the associated methods than finding a data control.

SUMMARY OF NEW FEATURES

Visual Basic 3.0

STANDARD EDITION	PROFESSIONAL EDITION Same as Standard Edition, plus:
Database engine from Microsoft Access, Version 1.1	Programmatic object layer gives you control over data and structure so you can create your own databases
Data access to BTrieve, dBASE, Microsoft Access, Microsoft FoxPro, and Paradox	Full SQL support, including ODBC drivers for Microsoft SQL Server, Oracle, and Sybase SQL Server.
Data-aware controls provide a visual layer to the Access engine for building database front ends without writing code.	Outline custom control
Support for OLE 2.0 automation	Crystal Reports for Visual Basic
Most Recently Used (MRU) file list	Custom Control Development Kit
Automatic Save on Run preference	
Pop-up menus	

Arranging a form to access data is easy with a special data control and one or more custom controls that are "data aware." You just place a data control on the form. Then at runtime, the form has VCR-type controls to allow the user to move to the first, previous, next, or last record. You set the database name as a property of the control and use the Record Source property to order and filter the data with SQL queries.

Data-aware controls have two new properties: "data source" is the data control on your form to which the control is linked; "data field" refers to the data displayed for the record chosen by the data control.

Many of the basic controls that ship with VB, such as the text box, check box, and picture box, are data-aware. If you set a text box to a textual field, then that control will display the value of the field during runtime. And if

While VB doesn't allow you to place security rules on an external database, it will support security that already exists. For example, you can use VB to query the user for a password, which can then be sent to the database by using a suitable property on the data control.

VB's Access engine gives developers rich database control. It supports transaction processing so you can use a "begin transaction" command and later roll back to where you began. The program supports multiple or single user access, depending on how you set certain properties in the data control, and it can enforce referential integrity rules.

DATA LIMITATIONS

While VB 3.0 provides wonderful data access in this area, it

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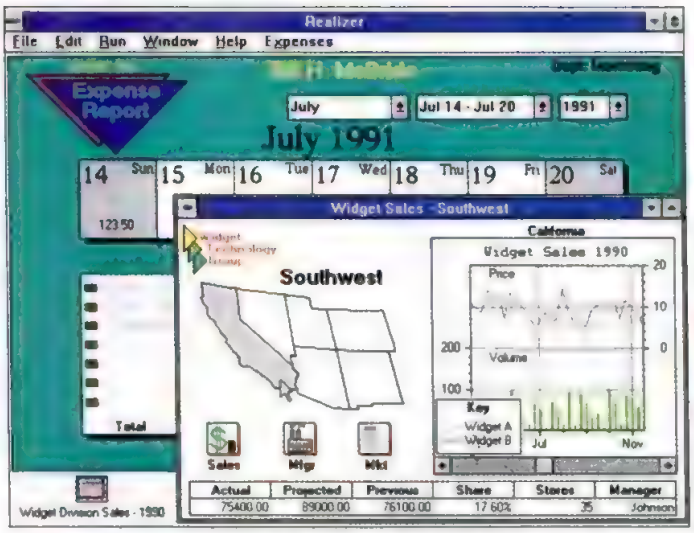

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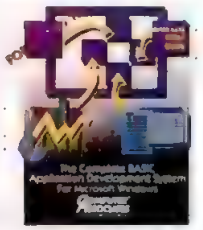

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Integrated Full-Featured Debugger	✔	
Single-Stepping, Call-Tree, Variable Display	✔	
Automatically Expandable Dynamic Arrays	✔	
Full Range Of Fast Array Operators & Functions	✔	
Mathematical, Statistical, Date-Time Functions	✔	
Dynamic Addition & Removal Of Form Objects	✔	
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Charts, Spreadsheets, Text Editors, Graphics, Animation, Scheduler	✔	
Ability To Run Multiple Applications Simultaneously	✔	
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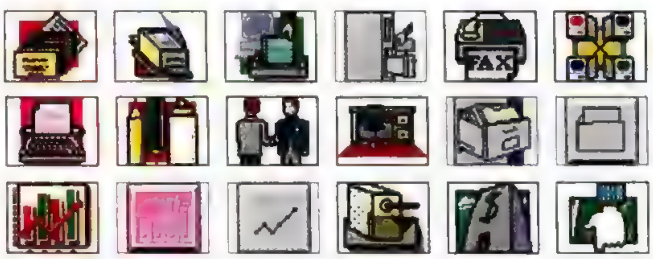

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CA-REALIZER Release 1.0 and Visual BASIC Release 1.0 compared 10/92. Cost comparison based on Visual BASIC Release 1.0 Suggested Retail Price. *PC Computing* quote appeared 10/91, pg. 90.
CIRCLE 381 ON READER SERVICE CARD

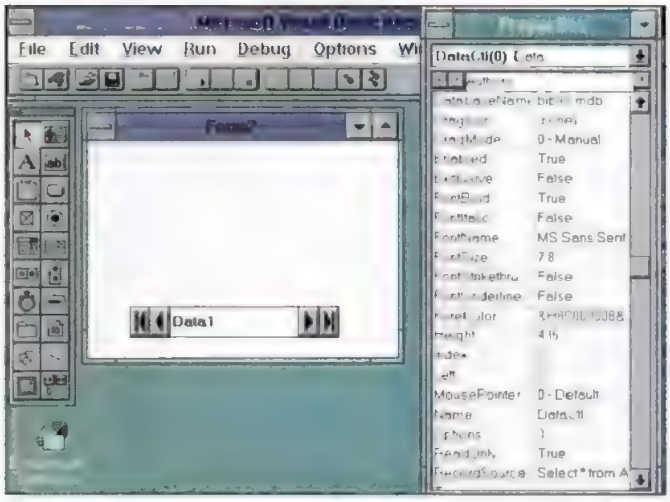
does have some limitations. The most serious is the lack of a custom control that gives you an immediate table view of your data. Both Agility/VB and Q+E/VB give you such controls. These third-party programs work with VB but use their own data engines.

Also, you may find that the use of raw SQL commands to sort, filter, and search databases is daunting. Controls that specialize in automatically formulating the SQL query for you would be useful.

Fortunately, it's easy for third-party vendors to make their own controls data-aware. You can expect to see third parties rush to enhance the scaffolding that is provided by Microsoft.

OLE 2.0: AN EXAMPLE

One of the few places that VB 3.0 is not backward-compatible with VB 2.0 is in its OLE control. You'll need to replace the OLE control in any VB 2.0 programs with the new control. Now, putting an OLE object on a form is as easy as drawing it and picking from the registration database.



OPEN DATABASE: *Add a data control to access external data.*

VB 3.0's OLE 2.0 control will shine once applications that support OLE automation are available. Although OLE 2.0 has gotten the most attention for its in-place editing, in the long run OLE 2.0 automation could be even more significant. At that point, programs will be able to "expose" commands to allow OLE 2.0 clients to use them.

For example, an OLE 2.0 version of Ami Pro might respond to an external string sent to it as a macro that you could then activate with the code

```
dim x as object
x = CreateObject
("amipro.macro")
x.command = MACRO where
MACRO is the macro string.
```

This aspect of OLE 2.0 replaces much of what dynamic data exchange (DDE) was used for. And it does this without the need for DDE conversations that are fraught with timeouts and other potential errors. Later this year when we have the first serious OLE 2.0 applications, we'll see if OLE 2.0 command links will be cleaner than DDE. The potential is exciting.

VB 3.0 has two tough acts to follow. VB 1.0 was revolutionary and VB 2.0 substantially improved every aspect of the product. While the 3.0 upgrade isn't as spectacular as either of these, anyone with interest in database access or OLE 2.0 will want it. Visual Basic is still the most pleasant way to develop Windows applications. □

FACT FILE

Visual Basic, Version 3.0 for Windows

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080

List price: Standard Edition, $199; Professional Edition, $495 ($395 until 7/15/93). Upgrades: from Standard 1.0 or 2.0, $49; Professional 1.0 or 2.0 to Professional 3.0: $99; Standard 1.0 or 2.0 to Professional 3.0, $149.

Requires: 2MB RAM (4MB or more recommended), 3MB hard disk space (22MB for full installation), Microsoft Windows 3.0 or later.

In short: The friendliest programming environment for Windows has added database access and OLE 2.0 support. The extras in the Professional Edition make it a compelling choice for most VB programmers.

428 ON READER SERVICE CARD

Fax Hardware

FaxPak Adds New Wrinkle to Plain-Paper Faxing

BY BEN MYERS

If you're a laser printer owner who hates curled-up faxes, check out the $299 FaxPak from Teledisk Systems. It uses your phone line, printer cable, and PC to turn your laser printer into a plain-paper fax machine.

FaxPak is a self-powered 2.25- by 6- by 8-inch (HWD) beige box with pairs of status lights and connectors for phone lines and parallel and serial ports. FaxPak stands between your PC and printer, responds to incoming faxes, and prints them directly if the printer is unencumbered.

If your printer is printing, has run out of paper, or is powered down, FaxPak stores the incoming fax until the printer is ready. Likewise, if FaxPak is printing a fax, it signals your PC that the printer is unavailable.

We sent FaxPak a three-page test document and found that when the printer was shut off, the product took the same 2 minutes 30 seconds to receive the fax as a traditional Group III fax machine took. With the printer on, FaxPak took a little longer to receive the fax—2 minutes 57 seconds—but it printed the first page during this interval. Printing the last two pages took an additional 2 minutes 30 seconds. FaxPak varied between 1 minute 10 seconds and 1 minute 40 seconds to print a page of text depending on the amount of text.

In another test, FaxPak stored 17 pages of text before the 768K capacity of its internal memory was exceeded. FaxPak stores the fax data in a compressed format.

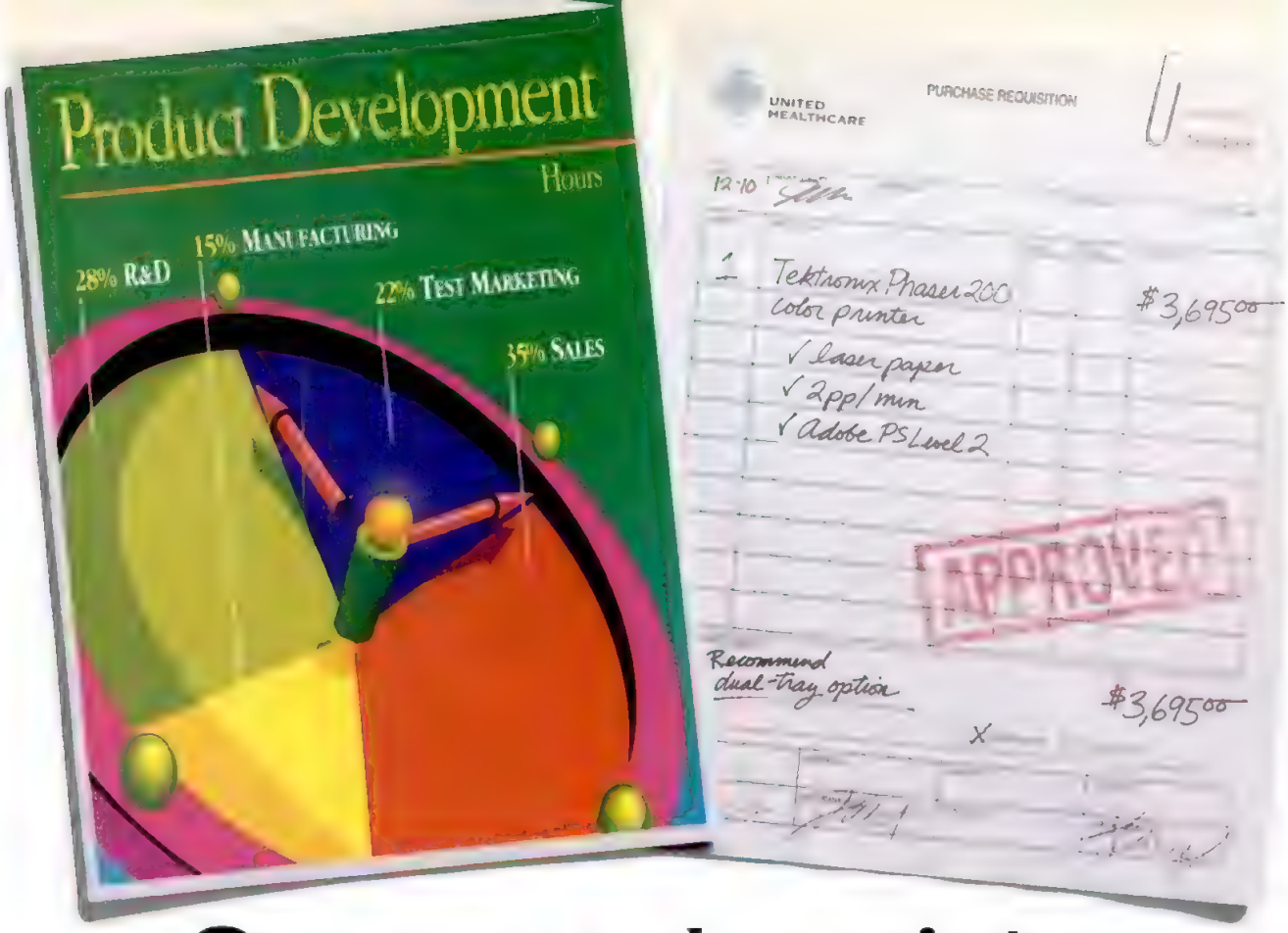
You can set up various FaxPak options—including the number of rings before answering, the printer resolution (150 or 300 dots per inch), the number of copies, and the paper size—via a touch-tone phone.

FaxPak consumes a modest 12 watts of power and operates independently of your laser printer, so you needn't worry about running up power bills by leaving it on overnight. Because it's a separate unit rather than a plug-in cartridge, it's compatible with any printer that interprets the PCL4 control language that drives the HP LaserJet printer (an updated version will also drive many dot matrix printers).

FaxPak is easy to set up, and you can forget about it once it's running except for on those rare occasions when you want to print and a fax is coming in.

- List price: *FaxPak, $299.* Requires: *HP LaserJet or PCL4-compatible printer, 1MB of printer memory for 300-dot-per-inch fax printing. Teledisk Systems Inc., 2401 Marinship Way, #200, Sausalito, CA 94965; 800-669-3700, 415-332-1122; fax, 415-332-0122.*

Circle 424 on reader service card



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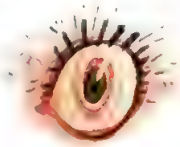

The eye when it sees color.

The Phaser 200 is compatible with virtually any business software and can print two colorful pages per minute. No, not two minutes per page—two pages per minute. And even at a speed like that, it still manages to print eye-catching color on common laser paper or transparencies using a separate input tray for each. You select the medium you want at your computer keyboard. And it switches automatically from user to user just as easily, using its parallel, serial, AppleTalk,™ or optional EtherTalk™ and Ethernet™ ports.

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CIRCLE 001 ON READER SERVICE CARD

Communications Software

MCI Express: Long-Awaited Savior Is Feature Rich but Ugly

BY RICK AYRE

People who live by e-mail need, above all, a communications program that's reliable. That explains why Lotus Express, as big and ugly as it is, has long been the program of choice for serious MCI Mail users.

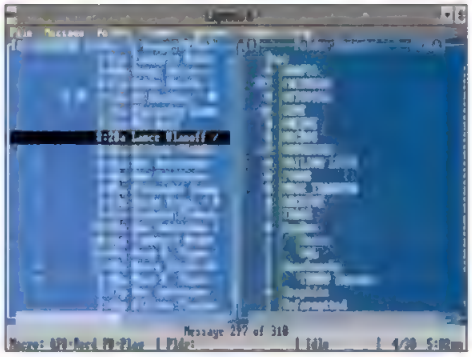
MCI bought the development rights to Lotus Express, remodeled it, and is now shipping MCI Mail Express for PCs for $35. While MCI Mail Express bears no resemblance to its namesake, the program is still reliable. It's also smaller and faster and adds some important new features, such as nested folders, a spell-checker, and improved search capabilities.

That's the good news. On the downside: The interface is new, but it's still downright lousy. On top of that, it adheres only loosely to any standard and is difficult to master.

Based on the new features, MCI Express sounds like it's the long-awaited savior for those saddled with the old Express. First, the formerly huge (about 220K) communications driver, which loads as a TSR, is now a manageable 36K. New features include pull-down menus, mouse support, 50-line display-mode support, improved folder management (long names, nested folders), the ability to view and edit two messages simultaneously, group message functions (such as group delete and move), enhanced address capabilities (address book, fax addressing templates), the ability to search on text across folders, and enhanced terminal features such as interactive downloading.

MCI has also significantly improved other features. The program now includes MNP error control, seamless support for 9,600-bps modems, better diagnostics, enhanced polling schemes, and better performance when running under Microsoft Windows.

Unfortunately, the interface does its best to hide the new functionality. For example, the Edit command is under the Message menu, while the Move and Copy functions are under the File menu. Once you do find the function you need, it's often confusing. For example, the first two choices under the Folder menu are "Switch" and "Open another." To a novice, that might sound like the same thing. The context-sensitive help offers little assistance.



MESSENGER: *MCI Mail Express lets you nest folders, a big improvement.*

The bottom line: If you use Lotus Express, you'll want to get the free upgrade to MCI Mail Express unless (and this is a big unless) you're so familiar with the old version that you don't want to bother learning new hotkeys. If you're a new MCI Mail user, you'll be amazed at the power even an unattractive e-mail program gives you.

• List price: *MCI Mail Express for PCs $35;* Requires: *500K RAM, 3MB hard disk space, DOS 3.0 or later. MCI, International Inc., 1133 19th St. NW, #700, Washington, DC 20036; 800-444-6245, 202-833-8484.*

Circle 422 on reader service card

Windows Communications Utilities

KingCOM Solves Shared Comm Port Conflicts

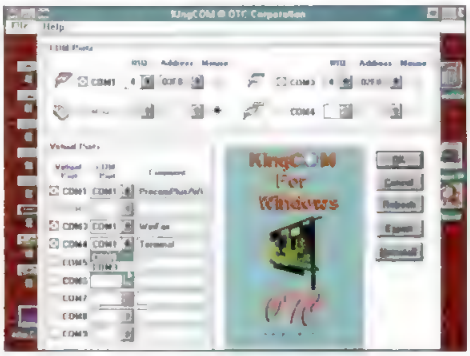
BY JOE SALEMI

Communications port support has always been one of Windows' weak points, especially for devices that need to share the same port for two different functions, such as a fax/modem. In many cases, your Windows fax software takes control of the comm port, preventing your software from working or giving you "COM port in use" errors. The $49.95 KingCOM for Windows, from OTC Corp., solves this problem and gives you more comm ports to use under Windows.

KingCOM addresses the problem by using Windows' multitasking capabilities to create virtual comm ports. Windows limits you to four hardware comm ports; with KingCOM, you can assign nine virtual comm ports to each of the hardware comm ports in your system.

During installation, KingCOM modifies your SYSTEM.INI file, replacing COMM.DRV with its own KINGCOM.DRV file. It also deactivates the lines in SYSTEM.INI that load Windows' virtual device support, since it replaces those functions.

The first time you run it, KingCOM scans your comm ports and automatically detects which ones have a modem attached. A Refresh option lets you rescan and reassign your system's comm ports, but if you add a specialized comm device, such as a serial connection to another system, you'll have to activate the comm port manually.



GOOD DRIVER: *KingCOM replaces the standard Windows comm port driver.*

KingCOM has a novice mode, but its expert mode gives you more flexibility in determining how the ports are virtualized. In expert mode, you can assign an alternate hardware comm port to a virtual port, which the device automatically switches to if the first port is busy.

The only problems we found with KingCOM are its lack of advanced high-speed support for 16550AFN UARTS and its lack of support for virtualizing DOS comm programs running under Windows. Because KingCOM uses its own comm driver, you can't use an advanced Windows comm port driver such as TurboCom to get this support. OTC says these features will be included in the next release.

• List price: *KingCOM, Version 1.0, $49.95.* Requires: *2MB RAM, 1MB hard disk space, Windows 3.1. OTC Corp., 17300 17th St., Suite J-117, Tustin, CA 92680; 800-769-6344, 714-832-4833; fax, 714-832-4563.*

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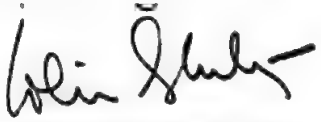

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Keystrokes required: 5

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uvwxyzABCDEFGHIJK
LMNOPQRSTUVWXY
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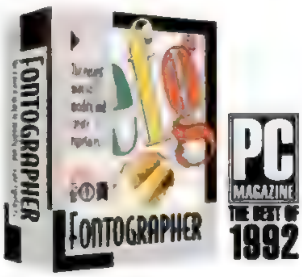

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Word Processing Utilities

Quicture Squeezes, Speeds Graphics in WinWord Files

BY EDWARD MENDELSON

Quicture takes away your excuse for making a cup of coffee while Microsoft Word for Windows is displaying the graphics in your files. WexTech Systems' $59 add-in takes the graphics out of your Word for Windows files, stores them as compressed files on-disk, and replaces them with generic-looking frames that can display a brief description of the image instead of the image itself. Your document loads, scrolls, prints, and saves at top speed. A few keystrokes can temporarily display one or more images for viewing or printing, or can restore the images from their compressed files back into the document.

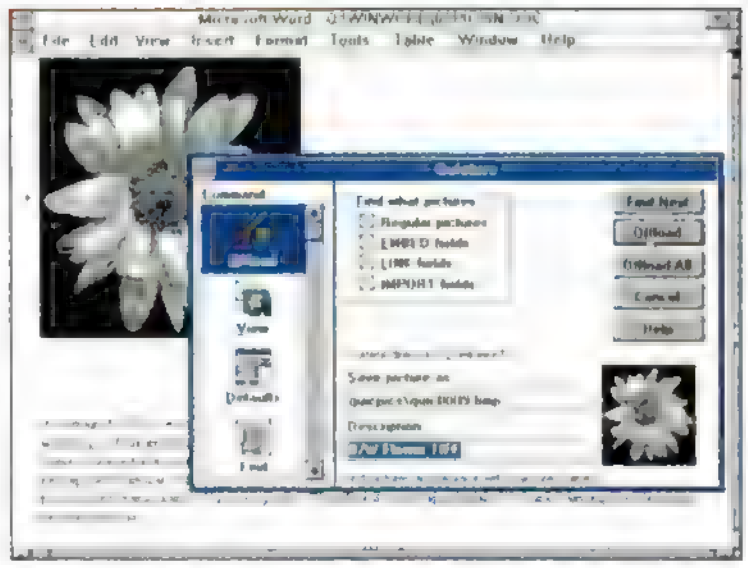
A Word for Windows file with a half dozen large bitmaps can easily exceed 1MB and can take a full minute to appear on screen. The same file with Quicture frames shrinks to less than 100K and takes seconds to appear. If you restore the graphics to your document, you have the option to delete the compressed files the program created.

The program looks and acts like an integral part of Word for Windows, with a menu that looks like Word for Windows' Options menu. You open the Quicture menu from WinWord's View menu or from a hotkey.

The menu lets you offload one or more graphics from a file, specify storage paths, fill in optional descriptions for each graphic, and select whether or not to compress graphics or leave them as they are. The compression technique is Windows' own RLL (run length limited) method that works only on 16- or 256-color graphics.

The first version of Quicture has a few bumps in it that the next version will smooth out. The most serious is a problem with large metafiles, which sometimes get restored to your document in sizes different from those you originally wanted.

If you send a document containing Quicture frames to a colleague who doesn't have Quicture installed, and your colleague double-clicks on a frame while modifying the file, the link to the offloaded graphic will be lost, and you'll have to restore it manually when you bring the document back to your system. But Quicture makes it easy to recover from errors. And nothing does more to speed viewing and editing of WinWord files with graphics in them.



OFFLOADING: *Quicture stores Word for Windows graphics in separate files.*

• List price: *Quicture, Version 1.0, $59.* Requires: *2MB of RAM (4MB recommended), Microsoft Word for Windows, Version 2.x; Microsoft Windows, Version 3.0 or later. WexTech Systems Inc., 310 Madison Ave., #905, New York, NY 10017; 212-949-9595; fax, 212-949-4007.*

Circle 429 on reader service card

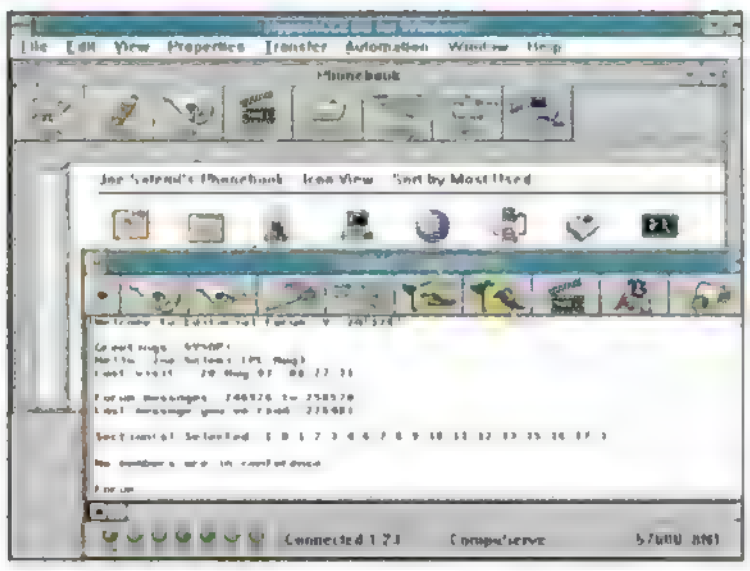
Windows Communication Software

HyperAccess for Windows Gets You On-line in Minutes

BY JOE SALEMI

Hilgraeve, maker of the DOS and OS/2 communications program HyperAccess/5, has finally brought its flagship product to Windows. HyperAccess for Windows ($199) has all the features you'd expect from a top-of-the-line comm package.

The newest HyperAccess also has some features that are unique among Windows comm packages. It includes a real-time virus scanner that can automatically scan files as they're being downloaded (though the scanner does not yet handle compressed files), and it has a unique, modular design with multithreading-like capabilities. And instead of using a proprietary scripting language, HyperAccess for Windows has a built-in C interpreter so C programmers can use their favorite language to create complex comm applications.



WINDOWS COMM: *HyperAccess for Windows is speedy, powerful, and easy to use.*

HyperAccess for Windows uses a technology Hilgraeve calls the Modular Communications Engine (MCE). MCE divides the program into three modules—low-level I/O, file transfer and terminal emulation, and user interface—that talk directly to the communications driver. MCE uses Windows' DDE (Dynamic Data Exchange) to link the modules together, providing virtual multithreading, and speeds file transfers by letting each module talk directly to the comm port.

Our informal testing showed that Hyper Access for Windows' file transfer rates, using both the Zmodem and CompuServe B+ protocols, were 10 to 15 percent faster than those of Procomm Plus for Windows.

Yet for all its power, HyperAccess for Windows remains one of the easiest comm programs to use. Phonebook entries default to icons, though you can change them to informative text by clicking on a toolbar icon. There are scripts for a number of on-line services and a dialog box for defining new ones. You can establish default settings for new sessions and make global changes to all existing sessions through a menu option.

HyperAccess for Windows also provides full drag-and-drop support under Windows 3.1. You can upload files by dragging their icons from the File Manager screen onto the upload dialog box.

HyperAccess for Windows has enough power to satisfy the most demanding user, yet it is so simple to use that a complete novice can be on-line in minutes.

• List price: *HyperAccess for Windows, Version 1.0, $199; upgrade, $69.95.* Requires: *2MB of RAM (4MB recommended), 1.7MB hard disk space, Microsoft Windows, Version 3.0 or later. Hilgraeve Inc., Genesis Centre, 111 Conant Ave., Suite A, Monroe, MI 48161; 800-826-2760, 313-243-0576.*

Circle 427 on reader service card

Gateway's 486 Fest!

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Nomad Notebooks

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Why settle for a 386 notebook when you can get a powerful 486 Nomad in the same price range? All three Gateway 2000 Nomad models are 486 systems with snappy performance that's still rare in notebooks. Plus, they're smaller than many notebooks, weighing just 5.6 pounds and measuring 8.5" x 11" x 1.8". No other notebook this size can beat the Nomad 450DXL's combination of performance and battery life! In *PC Magazine's* Battery Rundown Test, Nomad systems operated up to six hours on a single battery with power management enabled.

Party Reason — *No more squinting at a dim and fuzzy display!*

Nomad screens are big and brilliant — a full 10" VGA backlit display with 64 gray scale. You can use your Nomad in all lighting conditions.

Party Reason — *Three cheers for a great keyboard and mouse!*

Nice feel! The 79-key touch-type keyboard is comfortable, quiet and fast. Nomad 450DXL models now also include Microsoft's® Ballpoint™ portable mouse with Quickport,™ standard.

We have lots of options for our Nomads, too. Call for details!

Peripherals

Party Reason — *You'll save money on connectivity tools!*

TelePath™ Fax/Modem. It's everything you ever wanted in an internal fax/modem, including a great price! The Gateway 2000 TelePath is a 14,400bps modem, V.32bis, with 9,600bps fax capability. It's compatible with the standard AT command set and is downwardly compatible with lower modem speeds. Package includes software — WinFax Pro,® Crosstalk™ for Windows and Qmodem — plus a free CompuServe® trial membership. **$195**

Network Cards. Call for a selection of Ethernet cards and Token Ring adapters, installed and configured.

Microsoft Windows™ for WorkGroups. Networking made easy! Share files and printers, send electronic mail, schedule group meetings with the click of your mouse — and get everything you need in one inexpensive package. That's the beauty of Windows for Workgroups. Even a beginner can set up and configure a network with this fantastic product. Price includes an Ethernet adapter and software. Hardware and software are factory-installed. **$159**

Party Reason — *You'll save money on multimedia software and peripherals!*

CD-ROM Kit. You'll enter a whole new world of possibilities with your PC when you add a CD-ROM drive, giving you access to exciting new applications, databases and entertainment programs. With applications continually getting bigger, wouldn't it be convenient to get software on a single CD rather than piles of floppy disks?

Get galloping portability on your road trips with Gateway's top-of-the-line Nomad 450DXL.

And Peripherals!

Comparable CD-ROM drives usually retail for over $400. Manufactured specially for Gateway 2000, this kit includes CD-ROM, interface card and everything you need to add MPC-compliant CD-ROM to your PC. **$225**

Microsoft Windows Sound System.™ Here's the sound system designed for business, complete with a headset for private office use. You can "speak" commands to your PC for hands-free operation. Let your PC read numbers back to you for proofing spreadsheets. Embed audio messages in Windows OLE applications. Add audio to screen savers. Play your Ad Lib® and Sound Blaster™ games — and more! Our special Gateway price includes soundboard, microphone, headset and software. **$149**

Party Reason — *You'll save money on all kinds of extras from Gateway!*

Colorado Memory Systems™ TBU. 250MB internal automatic tape backup unit copies up to 9.5MB per minute with high-speed data compression. Reads previously formatted Archive™ tapes, too. Comes with easy-to-use DOS software, one tape and cable. 486 Fest price: **$195**!

CrystalScan™ 15-Inch Monitor. Non-interlaced color monitor with flat, square screen. If the system you want is advertised with a 14-inch monitor, you can upgrade at the time of purchase to a 15-inch monitor for only **$100**.

Panasonic® KXP2123 Color-Capable Printer. Add color to your documents with this 24-pin dot matrix printer. Includes Adobe Type Manager.® Call for 486 Fest price!

Texas Instruments® MicroLaser™ Plus Laser Printer. Never before has such a small, Postscript® laser printer offered so much speed and economy. The MicroLaser Plus is only 13.4" x 14.2", yet it prints 9 pages per minute at 300dpi. Call for 486 Fest price!

Gateway 2000™

486 Fest

We offer many other system options and upgrades, including 17- and 20-inch monitors, tape backup units, bigger hard drives, other software and more!

Call today!

The software and peripherals listed here are sold only with the purchase of a system. For details on our complete line of extras for Gateway customers, ask for our special add-on components division when you call.

GATEWAY2000

800-846-2063

Celebrate! We Give You More Software

That's right! We have even more reasons to party during Gateway's 486 Fest! We offer more free choices of application software with our systems than any other manufacturer. Plus, all software is pre-installed and ready to run the moment your system arrives. Hooray! No installation hassles!

With Nomad, mini desktop and our 4DX2-66 Best Buy systems, you get Works, one of the best integrated software packages on the market.

Party Reason — *Microsoft Works for Windows.*™

Works for Windows is the single program that combines all the tools you need to run a business: word processor, spreadsheet, database and electronic communications. It's simple to use yet provides power and functionality for advanced users.

With desktop and tower systems that include "choice of application software," you can select one of the following software packages. All applications are the latest versions.

Party Reason — *Microsoft Excel for Windows.*™

Microsoft Excel gives you unprecedented power and analytical functions, outstanding reporting and presentation tools, and easy charting. Includes faster ways to work. Reviewers consistently choose Excel as the best spreadsheet for Windows. It's an *InfoWorld* Product of the Year!

Gateway 2000™ 486 Fest

Party Reason — *Microsoft Word for Windows.*™

The original word-processing application for Windows is still the best selling! Drag and drop text and graphics around the page for easy creation of professional-looking documents. Existing WordPerfect® files (and other file formats) are usable in Word. You can even type a WordPerfect command and see Word's equivalent command automatically demonstrated on-screen!

Party Reason — *Microsoft Word and Bookshelf 92,® CD-ROM Edition.*

The most popular word processor for Windows now becomes the ultimate writing tool with an entire electronic reference library full of multimedia sights and sounds! Includes dictionary, encyclopedia, thesaurus, atlas, quotations, and more.

Party Reason — *Microsoft PowerPoint for Windows.*™

For easy, professional on-screen slide shows, overhead transparencies or 35mm slide presentations. Fast and flexible word processing, graphing, outlining and drawing tools give you more time to master your content instead of wrestling with your software.

Choices To Crow About!

Party Reason — *Microsoft Project for Windows.™*

Project management is easier and more flexible than ever! This program gives you the power and versatility to manage your schedules and resources more efficiently. That's why *PC Magazine*, *PC Week*, *PC World* and *Software Digest* call Project the best program in its category!

Party Reason — *The MS Entrepreneur Pack.*

Four great software packages in one! Microsoft Works,™ Publisher,™ Money™ and an Entertainment Pack.

Party Reason — *Borland Paradox® and Quattro® Pro for Windows.*

Paradox for Windows is the relational database that makes a powerful database easy to use. Now you have complete access to data, plus all the tools you need to create graphical applications in no time. You also get Quattro Pro, Borland's object-oriented spreadsheet, to complete your data management software package.

Party Reason — *The Windows Programmer Pack.*

Get everything you need to create programs for Windows: Microsoft QuickC for Windows,™ Visual Basic for Windows,™ Windows Control Development Kit,™ Windows Help Compiler™ and Windows Programmer's On-Line Reference.™

Party Reason — *Upgrade to the CD-ROM Edition of Microsoft Office.™*

You can upgrade from a choice of application software to Microsoft Office, CD-ROM version, for only $99! This single package has all the leading Windows applications: Word, Excel and PowerPoint.

The standard edition of MS Office is also available as an upgrade from a choice of application software for $175, or $499 as a second application.

Party Reason — *Upgrade from Works to choice of application.*

If the system you want comes with MS Works for Windows, you can upgrade to a choice of application software for only $100.

Software shown here is sold only with the purchase of a system. Software sold with systems includes the identical applications contained in retail packages but will not include the retail box. You get all master diskettes and manuals, shrink-wrapped and packaged in a Gateway 2000 box.

intel inside

Everyone's flocking to check out the life of the party, Gateway's 4DX2-66 Best Buy system shown with optional Labtec speakers.

GATEWAY2000

800-846-2063

The Whole Herd Is Dedicated To

Yes, this is the whole gang at Gateway 2000. We now number in excess of 2,000 people. We gathered everyone together for this 486 Fest kick-off photo so you could see all the friends you have in the business, and so we could renew our commitment to your complete satisfaction.

Despite some blustery weather, Ted, our president and founder, gave us an inspiring pep talk about customer satisfaction and value. He reminded us that we will be the best in this industry only as long as we remember the guiding principles of our company, best described in our mission statement:

We are Gateway 2000.
We care about and respect you, our customers.
We pledge to you that we will be honest, courteous and friendly.
If we make a mistake, we will admit it.
If you're unhappy about something, we'll do everything in our power to make it right.
We'll treat you as an individual and take special care to see that your individual situation is handled fairly.
We have fun working together, striving to be the most knowledgeable, productive and successful team in the world.
We blend our talents to continually offer higher quality, more innovative and useful products, at a value unmatched by competitors.
We will always be happy but we will never be satisfied.
And we will continually improve everything we do.
We will succeed, together as a team.
We are Gateway 2000.
We are the only logical choice!

Gateway 2000™

486 Fest

Providing The Best Service!

Party Reason — *You'll like doing business with people who care about you!*

Each and every person in this photo rededicated his or her efforts to achieving these goals. Like a married couple going through a second wedding ceremony after many years of marriage, our energies were refocused on what's important. And what's important to us is *you*!

Party Reason — *You get excellent after-the-sale support!*

Every Gateway 2000 system comes with a **30-day money-back guarantee**. If you don't like your system, send it back within 30 days for a refund. All systems come with a **one-year limited warranty** and telephone **technical support** for the life of the system from our award-winning tech department. You also get an **automated fax service** to supply you with detailed documentation on over 150 technical subjects, and a **lifetime BBS membership** for additional technical support and online forums.

We offer **on-site service** to most locations in the country (factory service only for notebooks). **Replacement parts** leave our factory as quickly as possible; we pay overnight shipping. Plus we now have **interactive documentation** on desktop systems with pictures and text right on your hard drive (in addition to comprehensive hardware and software manuals).

Party Reason — *It's so easy! Just give us a call!*

We make it easy for you to buy a Gateway PC, with convenient payment options including major credit cards and C.O.D. terms. Net 30-day terms and leasing options are also available to qualified commercial customers.

For a truly celebrated value, the choice is black-and-white: Gateway's 4DX-33.

intel inside

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Gateway 2000's Party List

4SX-25

- 25MHz 486SX Intel® Processor
- 4MB RAM
- 3.5" Diskette Drive
- 170MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- **Intel Pentium™ Technology Ready**
- Windows Accelerated Video w/1MB DRAM
- 14" Color CrystalScan® 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey® Keyboard
- MS-DOS® 6, Diags, Windows™ & Mouse
- MS Works for Windows™ 2.0

$1295

4SX-33

- 33MHz 486SX Intel Processor
- 4MB RAM
- 5.25" & 3.5" Diskette Drives
- 212MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- **Intel Pentium Technology Ready**
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- MS Works for Windows 2.0

$1495

4DX-33

- 33MHz 486DX Intel Processor
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 212MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- **Intel Pentium Technology Ready**
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- MS Works for Windows 2.0

$1895

4DX2-50V

- 50MHz 486DX2 Intel Processor
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- **Intel Pentium Technology Ready**
- ATI™ Ultra Pro Video w/1MB VRAM on VL-Bus™
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- Choice of Application Software

$2395

4DX2-66 BEST BUY

- 66MHz 486DX2 Intel Processor
- 8MB RAM, 64K Cache
- 3.5" Diskette Drive
- CD-ROM Drive
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- **Intel Pentium Technology Ready**
- Windows Accelerator w/1MB DRAM on VL-Bus
- 14" Color CrystalScan 1024NI
- Desktop Case (Tower Upgrade)
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- MS Multimedia Works, CD-ROM Edition

$2495

4DX2-66V

- 66MHz 486DX2 Intel Processor
- 16MB RAM, 256K Cache
- 3.5" Diskette Drive
- CD-ROM Drive
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- **Intel Pentium Technology Ready**
- ATI Ultra Pro Video w/1MB VRAM on VL-Bus
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- Choice of Application Software

$2995

4DX2-66E

- 66MHz 486DX2 Intel Processor
- 8MB RAM, 256K Cache
- 5.25" & 3.5" Diskette Drives
- 500MB 11ms SCSI Hard Drive
- 32-Bit EISA SCSI Controller
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Tower Case
- 8 32-Bit EISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- Choice of Application Software

$3495

NOMAD 425SXL

- 25MHz 486SX Intel Processor
- 4MB RAM
- 3.5" Diskette Drive
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- Backlit 10" VGA Screen, 64 Gray Scale
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8," 5.6 Lbs.
- 6-Hr. NiCad Battery & AC Pack
- 1 Parallel / 1 Serial Port
- 79-Key Keyboard & FieldMouse™
- MS-DOS and Windows
- MS Works for Windows

$1995

NOMAD 450DXL

- 50MHz 486DX2 Intel Processor
- 3.5" Diskette Drive
- Backlit 10" VGA Screen, 64 Gray Scale
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8," 5.6 Lbs.
- 6-Hr. NiCad Battery & AC Pack
- 1 Parallel / 1 Serial Port
- 79-Key Keyboard & MS Ballpoint
- MS-DOS, Windows & Works for Windows

$2495
(With 4MB RAM and 120MB Hard Drive)

$2795
(With 8MB RAM and 200MB Hard Drive)

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Monitors

Full-Page Windows Monitor Bends Sideways

BY BRUCE BROWN

Microsoft Windows word processor users take note. Portrait Display Labs' $799 Portrait/15 Plus monitor lets you view a full page of text on-screen. This multifrequency 15-inch monitor swivels easily between the "normal" landscape mode used by other monitors and Portrait Display Labs' unique portrait mode.

You can only use the Portrait/15 Plus's portrait mode with Windows applications; DOS applications display only in landscape mode. When you're in Windows and are using either portrait or landscape mode, you just tap the correct key combination, the screen dims, and then it comes back on in the other display mode. Then you physically swivel the screen to portrait or landscape position. It then automatically degausses.

The Portrait/15 Plus uses a flat-square tube and has a 0.28-mm dot pitch with both antiglare and antistatic coatings. Built to meet the Swedish MPR II standards for electromagnetic emissions, the unit will run in resolutions from 640-by-480 to 1,024-by-768 with a maximum 72Hz vertical refresh rate in 1,024-by-768 mode.

You can't use the Portrait/15 Plus with just any Windows system. In addition to needing Windows 3.1, the monitor also requires a video card with one of several supported Windows video accelerator chip sets: ATI mach 8 and mach 32, Radius SVGA, S3, Tseng ET4000, Video Seven, or XGA-2. Portrait Display Labs doesn't sell video boards but has a deal bundling an S3 801-based Orchid Fahrenheit 1280° ISA or VLB board for $200 when you buy it with a Portrait/15 Plus monitor.

In testing the display with a Fahrenheit 1280° board, we discovered that the current drivers didn't work when the board was installed on a 386 system (there was no problem on a 486 system). Portrait Display Labs said the problem occurred only with S3 801 video chips; a fix is expected soon.

YOUR CHOICE: *The Portrait/15 Plus works as a landscape or portrait monitor.*

Windows users will like the Portrait/15 Plus's ability to provide maximum screen real estate either horizontally or vertically. Once installed, the monitor is a snap to use and a convenient tool for getting a better view of your Windows apps. For users of OS/2, Portrait Display Labs is preparing a set of drivers that will support IBM's 32-bit graphical operating system in portrait mode.

• List price: *Portrait/15 Plus, $799.* Requires: *1MB VRAM on a VESA-compatible Microsoft Windows video accelerator using ATI, Radius SVGA, S3, Tseng ET4000, Video Seven, or XGA-2 chip sets; Windows 3.1. Portrait Display Labs, 46712 Fremont Blvd., Fremont, CA 94538; 800-858-7744, 510-249-0444; fax, 408-655-6099.*

Circle 431 on reader service card

CD-ROM Utilities

Lightning CD Makes CD-ROM Drives Seem Faster

BY MARK BROWNSTEIN

Even the fastest CD-ROM drives are slow when compared to most hard disks. And though newer drives feature improved data transfer rates and faster access times, they still need speeding up.

Lucid Corp.'s $99.95 Lightning CD, a CD-ROM cache utility, addresses the speed problem by doing what most cache programs do: watching the read requests you make from the drive and storing frequently accessed data in memory. The next time you look for the information, Lightning CD reads it from the cache, rather than from the much slower drive.

Lightning CD can remember the results of searches or disk reads, and it quickly recalls the data. For example, a search of the Front-Page News CD-ROM for articles on the Federal Republic of Germany took 10.61 seconds without Lightning CD, 8.5 seconds the first time the search was performed with Lightning CD, and only 5.65 seconds once the search results were in the cache. The time it took to access the first article dropped from 12 seconds the first time it was read to a barely measurable 0.6 seconds once it was in the cache.

For games and other CD-ROM applications, the benefit of having a cache like the one from Lucid Corp. is significant. In addition, Lightning CD's intelligent "read-ahead" component can anticipate the next area that will be read by the application and can load it into RAM while the application is using current data. This can help reduce the pauses that normally occur when a program has to read from disk.

If you want to use Lightning CD, you'll have to forgo any other caches because it replaces Windows' SMARTDRV. It acts as the only cache in the system and it does a good job. On one elaborate Windows-based test system, Lightning CD reduced the time required to launch Windows from 2 minutes down to 68 seconds.

The utility did require some memory tuning so that we could run large applications under Windows. Its behavior under Windows, however, yielded no unpleasant surprises. You can even set up different cache profiles to fine tune performance for each CD-ROM.

Utilities included with Lightning CD give it even more functionality. Disk Watch, a utility that flashes the drive letter on the screen whenever the system issues a read request to the hard disk lets you know that the cache is working; LKey speeds up keyboard performance; and LScreen speeds up screen refresh on systems that aren't using ANSI.SYS.

Lightning CD also includes a tree-deletion utility that deletes the contents of a directory and all subdirectories below it. The package also includes Best of the Bureau, a CD-ROM with samples of products published by the Bureau of Electronic Publishing.

• List price: *Lightning CD, $99.95. Lucid Corp., 101 W. Renner Rd., #450, Richardson, TX 75082; 800-925-8243, 214-994-8100.*

Circle 425 on reader service card

Mathematical Software

Maple V Looks Better with Improved Graphics

BY BARRY SIMON

Maple and Mathematica have long battled at the top of the mathematical software market, with Maple winning praise for its speed and smoother DOS interface and Mathematica gaining points for the considerably superior graphics of its Windows version and its notebook interface.

Now the next round begins. The $795 Maple V, Release 2.0, from Waterloo Maple Software has much more comprehensive graphics that now rival those of Mathematica. Contour and density plots, lighting models, animation, and implicit plots have all been added.

DOS and Windows versions of Maple V come in the same package and share large amounts of code. The Windows version has what Maple calls worksheets, which, like Mathematica's notebooks, let you produce compound documents with mathematics, formatted mathematical output, plots, and text.

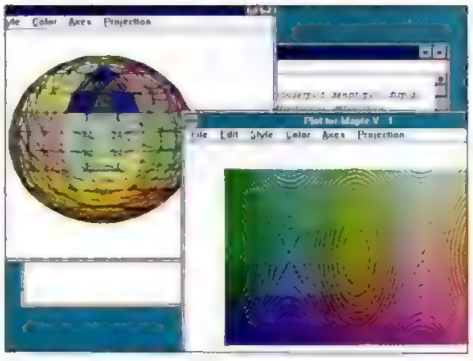
MORE MATH

Release 2.0 adds symbolic Fourier transforms, and symbolic integrals can now handle algebraic, elliptic, Heavyside, and Dirac functions. There is now a complex number data type that is understood by many built-in functions, and an "assume" facility that lets you tell Maple that it can suppose, for example, that some symbolic variable is positive.

New specialized functions include padic analysis, Gaussian integers, and combinatorial networks. An especially intriguing addition is an experimental new language called Gauss, which runs on top of Maple and is translated into Maple behind the scenes. Gauss is based on the idea of parameterized types, a notion introduced in IBM's internal Scratch Pad project and used in the Axiom product available on some minicomputer systems.

GRAPHICS INTERFACE

In the DOS version, typing in a plot command shifts the program into graphics mode and displays the desired plot. You can pop up a menu that lets you change perspective and coloring, or add axes and labels. But when you're finished looking at the plot in graphics mode, you must return to text mode.



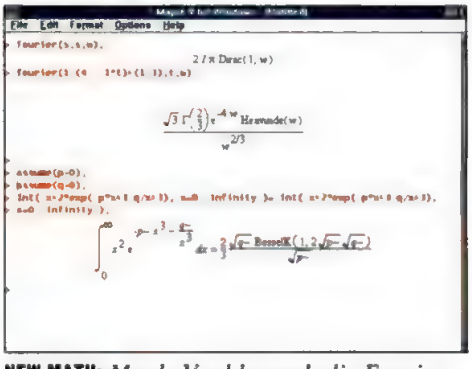
NEW PLOTS: *Maple V now includes implicit surfaces and contour plots.*

The Windows version is more convenient. The plot is placed in a window, but you can minimize it and recall it later. You can even paste a plot, complete with carefully chosen color and other parameters, into a worksheet and recall it from one session to the next without recalculating. Since recalculating a plot can take a while, this is a great convenience.

The two errors our tests found the last time we tested math software ("Symbolic Math Software: It's Not Just for Mainframes Anymore," August 1992) remain uncorrected. Maple still computes the integral defining the gravitational potential of a ball incorrectly, and it remains unable to simplify the square root of a quadratic surd. Mathematica had the same errors, but two other competitors, Derive and Macsyma, did not.

One interface glitch that needs correcting: You have to load packages explicitly. For example, before using the Plot3D feature, you have to type in the "with(plots)" command. That forces you to keep track of which routines (that go beyond the basic core) are found in which packages, and that's a real hassle.

On-line help is clearly written; it has a well organized hierarchy and, new to this version, lots of examples. But it has neither hyperlinks nor an index. To use common help for DOS and Windows, Maple V uses a homegrown help engine that is adequate but no match for the slick one that ships with Windows.



NEW MATH: *Maple V adds symbolic Fourier transforms and an assume facility.*

MAPLE OR MATHEMATICA?

If you have large symbolic calculations to do, you'll want Maple or Mathematica. The choice is not an easy one. If you have limited hardware, Maple wins. It's often slow on a 4MB system, but it runs. It's much faster on systems with 8MB RAM, where Mathematica for Windows just barely runs. While Maple will use a math coprocessor, having one is not essential, as it is for Mathematica.

If you need to produce lots of live mathematical documents, you'll choose Mathematica. While Maple was catching up to the notebook capability in Mathematica 2.1 for Windows, Wolfram Research released Mathematica 2.2, which caught up to the notebook capabilities of Mathematica on NeXT and Macintosh machines, including paragraph by paragraph font support. Maple forces all text input in a document to use a single font.

Other than that, there is no compelling reason for users of one program to switch to the other. For new users, the choice will depend on what your coworkers are using. But make no mistake: This is a significant upgrade of a powerful product. It won't disappoint new users, and any current user will want to upgrade to the new version.

- List price: *Maple V, Release 2.0 for DOS and Windows, $795; available for a limited time directly from Waterloo or from MathSoft (800-628-4223) for $395.* Requires: *3MB of RAM, 11MB to 16MB hard disk space; DOS 5.0 or later, Microsoft Windows 3.1; math coprocessor recommended. Waterloo Maple Software, 450 Phillips St., Waterloo, Ontario, Canada N2L 5J2; 800-877-6583, 519-747-2373; fax, 519-747-5284.*

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No time wasted learning nonstandard language extensions	Yes	No
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No 79-page "migration guide" required to identify programming incompatibilities	Yes	?
Dramatically improved performance	Yes!	

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"The new speed demon"

—*PC Magazine*, May 11, 1993

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*dBASE Compiler for DOS is sold separately. dBASE RunTime owners qualify for special $199.95 upgrade price for the dBASE Compiler. Compiler upgrade free to all registered dBASE Developer's Edition owners. Copyright © 1993 Borland International, Inc. Offer good in the United States and Canada only. All prices in U.S. dollars. Dealer prices may vary. BI 5525

Windows Word Processors

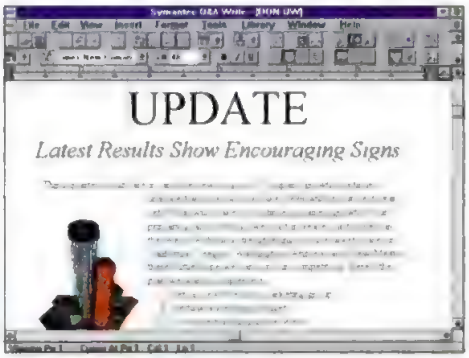
Low-Cal Q&A Write 3.0 Is Good for Notebooks

BY DON WILLMOTT

Why would anyone consider buying a Microsoft Windows word processor that's essentially a subset of an unsuccessful predecessor? A $69.95 price tag helps.

Symantec Corp. is hoping that Q&A Write, Version 3.0 for Windows, will be more successful than JustWrite, the underwhelming word processor from which it evolved. Positioned as a small, low-demand package best suited for use on notebooks, Q&A Write takes up only 4MB of hard disk space when fully installed.

What's in and what's out? While Q&A Write does have professional word processing tools like a spell-checker, a thesaurus, an outliner, a table generator, and OLE and DDE hooks, it doesn't include high-end features such as drawing tools, redlining, or an equation editor. These are features that you generally find in more expensive word processors like Microsoft Word for Windows or WordPerfect for Windows, but Symantec believes that most people don't use these kinds of features anyway.



MORE FOR LESS: *Low-cost word processing.*

The end result is a lean program that looks like most other Windows word processors, complete with a customizable toolbar along the top and drag-and-drop editing tools. Q&A Write has its own file format, but it automatically reads and writes Microsoft Word for Windows and WordPerfect for Windows documents.

Given the Symantec family connection to the Q&A database program, it's little surprise that there's a special focus on mail-merge; the program can handle dBASE, Paradox, and Q&A files. The mail-merge is traditionally implemented. However, the kind of attention to usability that both Ami Pro and Word for Windows flaunt in their mail-merge isn't as evident here.

FAX AND E-MAIL

In keeping with the portable word processor theme, Q&A Write includes fax and e-mail capabilities. The program can connect to any MAPI- or VIM-compliant e-mail package you use. Just click on the Send Mail tool, and the program transmits the current document as an attachment. Faxing works the same way. If you have Windows fax software running on your system, sending your current document off as a fax is a simple one-step process.

Q&A Write doesn't pretend to be a direct competitor to any $495 word processor, and it isn't. But at its rock-bottom price, it's a good way to get a start in Windows word processing and save a little disk space at the same time.

• List price: *Q&A Write, Version 3.0 for Windows, $69.95.* Requires: *2MB RAM, 1.7MB hard disk space, Windows 3.1. Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-252-3570; fax, 408-253-4092.*

Circle 432 on reader service card

Video Editing Software

Make Movies for Home and Business with VideoDirector

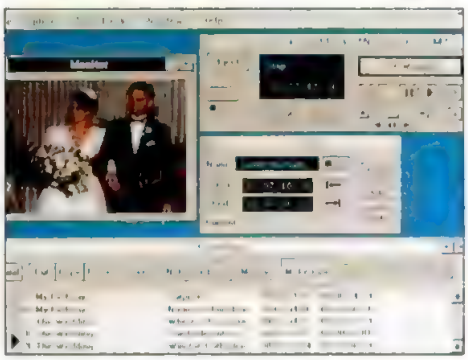
BY STEVE ROSENTHAL

Videotape can be an effective business tool, but not in its raw, unedited form. To trim, cut, and resequence footage you need video editing software. Gold Disk's VideoDirector for Windows ($199.95), takes clips from a Hi-8 camcorder, assembles them into a polished home movie or business videotape, and transfers your masterpiece onto a VHS tape.

Most video editing systems rely on costly dedicated equipment or on PCs with high-end hardware that digitizes the video signal and stores it on a hard disk. VideoDirector, however, does the job in the least costly way by working directly with your camcorder's analog signals. It works with most Hi-8 camcorders that have a LANC (Control-L) connection and with any VHS deck that has an infrared remote control.

A serial "Smart Cable" connects to both a camcorder (the source) and a VCR (the destination), letting you control both from your computer. As you view the videotape on a TV or a TV-format monitor, you mark the start and end points of the clips you want and give them a descriptive name. You can then trim and sequence video clips into scenes and assemble them into a final production that's recorded onto your VHS deck.

With VideoDirector's tape library you can keep track of clips from muliple tapes. You can also merge a new tape into the database or remove clips on tapes you've recycled.



LETS GO TO THE VIDEOTAPE: *VideoDirector puts video editing on the desktop.*

If you have a video-in-a-window card that uses the Windows MCI control commands, VideoDirector can display video footage in an on-screen window. But you'll probably find the image too small for serious work. The program also works with VCRs that have computer interfaces, such as the Sony Vdeck or the Selectra-modified Panasonic AG-1960.

VideoDirector has no separate control for audio editing. Unless you use a source deck with built-in time code, you'll have to recalibrate the tape by hand. Even then, your edits are approximate, but that should be good enough for making informal training tapes or capturing the best moments of your vacation.

• List price: *VideoDirector for Windows, $199.95.* Requires: *Microsoft Windows 3.1, video overlay board or separate monitor, camcorder with LANC (Control-L) socket, VCR with infrared or computer control. Gold Disk Inc., 5155 Spectrum Way, #5, Mississauga, Ontario, Canada, L4W 5A1; 800-465-3375, 416-602-4000; fax, 416-602-4001.*

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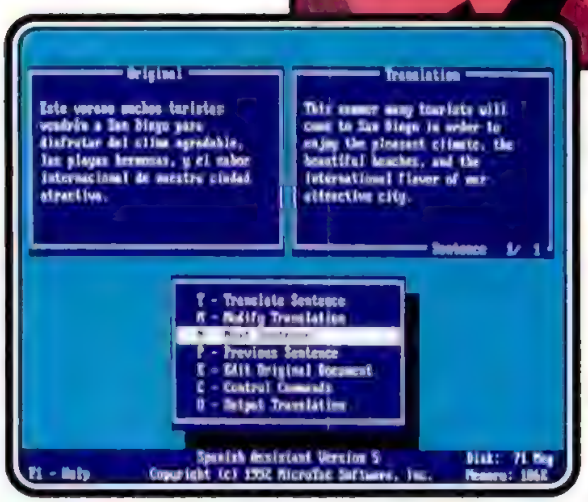

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■ Windows Communications Software

Smartcom for Windows Installs Best on Hayes Modems

BY RICK AYRE

With a multitude of connectivity options (such as ISDN), strong foreign language support, and a robust script-development environment, Hayes's new $149 Smartcom for Windows is a strong contender in the crowded Windows communications category. Its install program, however, is inadequate for all but Hayes modem owners, and the program doesn't include log-on scripts for popular on-line services.

Smartcom for Windows supports all of the important file-transfer protocols, from XMODEM to ZMODEM, as well as the latest CIS-B for CompuServe users. It offers more than the usual connection options, from direct connect to ISDN (both circuit-switched V.120 and packet-switched X.25) and has important terminal emulation options, such as ANSI BBS and the VT family. There are even some options, such as Prestel and Teletel, that matter only to Europeans.

More important, Smartcom presents all these features in a clean Windows interface that makes finding what you need straightforward. The menus are logical and well organized. For help you turn to the excellent on-line help system or to the complete written documentation.

Like most Windows applications, Smartcom for Windows has a toolbar, here called the Button Palette. It's well situated, easily customizable, and features icons that clearly indicate where clicking on them will lead. Among the convenient tools you'll find is a .GIF viewer, for viewing graphics files in that popular format.

GOOD FOR DEVELOPERS

Power users are well served by Smartcom for Windows' robust development environment. The Simple Communications Programming Environment or SCOPE is a scripting language with a long and strong heritage. It draws from earlier Hayes communications programs, such as Smartcom III and Exec, to allow broad compatibility across packages, yet it gives you the ability to develop custom applications that take full advantage of the Windows interface.

FACT FILE

Smartcom for Windows, Version 1.0

Hayes Microcomputer Products Inc., 5835 Peachtree Corners East, Norcross, GA 30092; 800-964-2937, 404-441-1617; fax, 404-449-0087

List price: $149 ($49 until July 31, 1993)
Requires: 2MB RAM, 2.5MB hard disk space, Windows 3.0 or later
In short: Smartcom for Windows features stong scripting and has high-end tools, but watch out for an installation that favors Hayes modems

403 ON READER SERVICE CARD

All good communications programs have a Learn feature as an extension of their scripting languages. Smartcom is no exception and will watch what you do, both with mouse clicks and typing from the keyboard, and generate scripts that mimic those actions.

One of the slickest features in Smartcom is the Smartcom Editor. You can use it to edit ASCII text files, but it will also edit binary files and edit and view ANSI graphics. If you use it to create SCOPE scripts, you can browse through a list of programming functions and insert the one you want into your script, as well as compile and debug from inside the editor.

THE WORLD OF HAYES

In the room-for-improvement category, Smartcom's use of fixed pitch fonts (and only a few sizes at that) is unnecessarily limiting in a way many Windows users will find disconcerting. Crosstalk for Windows, Version 2.0, does font handling in a much more elegant way, even auto-sizing fonts to the open window as you change its size (First Looks, January 26, 1993).

It's also surprising that, unlike most comm programs, Smartcom comes with no sample scripts that you can tailor to log on to the major on-line services such as CompuServe and MCI-Mail. The only log-on script supplied with Smartcom is for the Hayes support BBS.

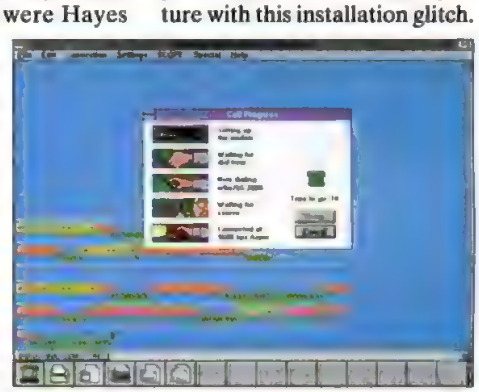
Most troubling, the only modems we could get Smartcom to work with following a complete installation were Hayes modems. Hayes has always sold software tailored to its own hardware; its documentation even states that explicitly. What that means, unfortunately, is that the Smartcom installation program doesn't ask you what kind of modem you're using, and by assuming that you've got a Hayes modem, it sets up the default settings to work well with Hayes modems.

We tested the wisdom of that decision by installing Smartcom on three computers and trying it with five modems. Its defaults worked with only two of the modems: the Hayes Ultra 96 and a PPI 14400FX, which is made by a Hayes subsidiary. It didn't work with an Intel SatisFAXtion 400, a UDS Motorola FasTalk FAX32, or the 9,600-bps modem that comes factory-installed in the Compaq LTE/Lite 25C. It was possible to change Smartcom to work with the other modems once we discovered that the trick was to check the box labeled "Use reduced command set."

INSTALLATION TIP

Once we checked the box, which you can find by dropping down the Settings menu and clicking on Modems, all three modems worked well with Smartcom. Until that point however, none of the three would connect to remote modems and there was no indication what the problem might be. Smartcom would seem to initialize the modem correctly, dial the number, and make the connection, but then Smartcom would suddenly and inexplicably hang up.

It's strange that Hayes, a communications company that pays attention to the details in both its hardware and software products, misses the bigger picture with this installation glitch. If you take the trouble to get by it, though, Smartcom has attractive tools for advanced communicators. □



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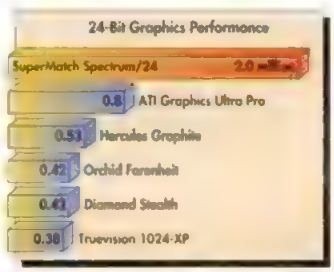

Note: Tests based on the PhotoShop 24-bit graphics benchmark performed by Jim Pedde. All tests run on a 33 MHz 80486-based EISA system. Iterations are in millions of pixels processed per second.

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■ Laser Printers

New Kyocera Ecosys: Easy on The Earth, Easy on the Budget

BY ALFRED POOR

Kyocera Electronics likes to emphasize the environmental aspects of its newest laser printer, but many people will find the Kyocera Ecosys a-Si Printer FS-3500A to be as friendly to the economy as it is to ecology.

Based on a new 18-page-per-minute print engine, the FS-3500A uses the same amorphous silicon technology for its photosensitive drum that the slower Ecosys FS-1500A uses. The drum is harder and more durable than the typical laser printer drum, and special ceramic particles are included in the toner to keep the surface polished and clean. The drum is designed to last for the life of the printer; the only consumable besides paper is the toner.

By cutting down on consumables, Kyocera has also slashed the operating costs. While most one-piece toner/drum cartridge printers have costs in the range of 2 to 3 cents per page (not including cost of the paper), Kyocera claims operating costs of less than a penny per page. If you are running the FS-3500A at its duty cycle of 50,000 pages per month, the cost savings could pay for the $3,895 printer in less than eight months.

Churning out 100 reams of paper is easy with the FS-3500A, given its RISC-powered engine. The basic model has only a single 250-sheet paper tray, but you can add one or two 500-sheet trays, as well as a duplexer, a stacking bin, and an envelope feeder. It comes with simultaneously active parallel and serial ports and an expansion slot which accepts optional AppleTalk, Ethernet, or Token-Ring network adapters. You can also set each port to use a different emulation mode, although there is no automatic switching.

The basic model comes with Diablo 630, Epson LQ-850, HP LaserJet III, HPGL, and IBM Proprinter X24E emulation modes. While this broad range of emulations is not nearly as important today as it was five years ago, it can still matter if you use old software. The FS-3500A also includes support for Kyocera's Prescribe II printer language, which can produce sophisticated text and graphics, as well as 42 different types of bar codes including Postnet. The FS-3500A also comes with a whopping 87 bitmapped and 59 scalable fonts, although the number available depends on the printer emulation.

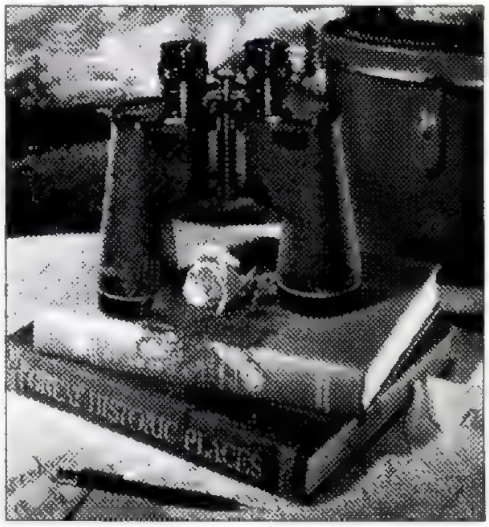
The FS-3500A comes with 2MB of memory, but you can take it up to 18MB using standard SIMMs. You can also add ROMs for Kyocera's KPDL, a PostScript Level 1 emulation language, which provides its own 47 font outlines as well.

17 PAGES PER MINUTE

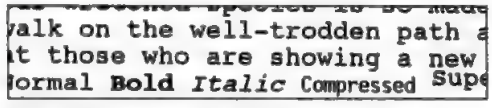
We tested both the LaserJet III and PostScript modes using PC Magazine Labs' printer benchmark tests. The FS-3500A's speed was obvious for both text and graphics. Under PCL, it managed 17.0 ppm for the text speed test, and 3.7 graphics pages per minute in the graphics test. This is more than 2 ppm faster on text (but 0.5 gppm slower for graphics) than the new HP LaserJet 4Si printer. Under PostScript, the results were 16.0 ppm for text and 0.6 gpmm for graphics, which is only about 1 ppm faster on text but nearly a third slower on graphics than the HP 4Si MX. The slower graphics speed under PostScript is all the more significant since the HP was printing a 600-dpi image, while the Kyocera was only printing a 300-dpi image.

The differences in resolution are not as important as you might expect, however. The Kyocera engine uses a 300-dpi LED imaging system but is able to modulate the signals so that you get an equivalent vertical resolution of 1,200 dpi through resolution enhancement. As you might expect, by following this approach, the printer smoothes jaggies more effectively for near-vertical lines than for near-horizontal ones, but the overall effect is equivalent to the average 600-dpi printer output. The print quality is excellent, with smooth coverage of solid black areas and sharp edges with no dropouts.

GREEN PRINTER: *The FS-3500A's drum lasts the life of the printer.*



GRAPHICS: *A 200-dpi example.*



TEXT: *87 bitmapped and 59 scalable fonts.*

Other features worth noting include the printer's remarkably small footprint and its relatively light weight of 35 pounds. The FS-3500A is easy to set up since the drum is already installed. You insert the developer unit, add toner, and power up. The front panel has an LCD message window with two 16-character lines, and the raised membrane buttons make it simple to select options. The FS-3500A also has slots for two PCMCIA cards which can be used to store fonts and macros, such as scanned images.

Though you'll probably want to take advantage of the paper handling options if you plan to make heavy use of this printer, the FS-3500A is a heavy-duty, high-speed printer that won't take up much of your office space or your budget.

- List price: *Kyocera Ecosys a-Si Printer FS-3500A, $3,895. Kyocera Electronics Inc., 100 Randolph Rd., Somerset, NJ 08875; 800-323-0470, 908-560-8380.*

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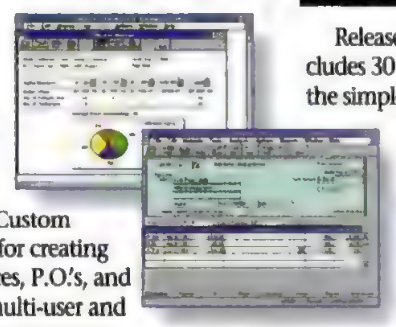

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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

NEW

At $149, TurboCAD Breaks New Ground in Windows

IMSI's TurboCAD for Windows 1.0, a $149 cousin of the $495 TurboCAD Professional for Windows, is designed to inspire TurboCAD for DOS users to make the Windows switch (crossing over costs $29.95). The program features high-end CAD tools, such as curve drawing and double lines, and has macro facilities and auto-dimensioning that surpass those of the DOS version. One nice interface touch: Words describing each icon on the toolbars appear under the cursor when it points at the icon.

• List price: *TurboCAD for Windows, Version 1.0, $149. IMSI, 1938 Fourth St., San Rafael, CA 94901; 415-454-7101; fax, 415-454-8901.*

Circle 405 on reader service card

NEW

Nisca Introduces First Portable Full-Page Scanner

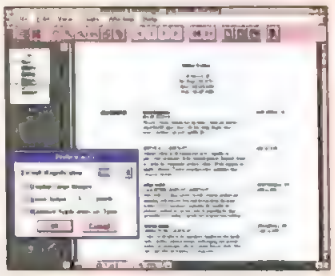
Now you can fit a full-page, gray-scale scanner in your briefcase alongside your notebook PC, thanks to **Nisca** and its Niscan Page scanner. The Niscan Page measures 2.5 by 12 by 2.75 inches (HWD) and weighs just under 3 pounds, with a maximum resolution of 400 dots per inch and 256 shades of gray. It's battery-operated (an A/C adapter is also included) and plugs directly into the parallel port to provide approximately 30 full-page scans per charge. If you snap off the base plate, you can use it as a hand scanner. It comes bundled with Ocron's Words & Pictures package, giving you optical character recognition, image editing, and fax-on-the-fly capabilities.

The Niscan Page scanner: Portable full-page scanning.

• List price: *Niscan Page, $799. Nisca Inc., 1919 Old Denton Rd., #104, Carrollton, TX 75006; 214-242-9696; fax, 214-245-0942.*

Circle 407 on reader service card

HOT PROSPECT



Adobe Acrobat: Cross-Platform File Viewer Is Ready to Go

Ever since it was first announced at Fall Comdex, potential users of **Adobe Systems**' cross-platform file viewer, Acrobat, have been imagining creative ways to implement this groundbreaking technology in corporate settings. Acrobat lets users of both Windows and Macintosh systems view files that have been converted into the proprietary .PDF format. (Other platforms will be available soon.) The Acrobat family consists of separate modules. PostScript files are converted to .PDF via the Acrobat Distiller, and all other .PDF files are created by the Acrobat Writer. Anyone who wants simply to view files gets the Acrobat Reader.

Fonts are not an issue. Adobe uses font substitution techniques that guarantee that the page you view on your PC will look just like it did when it was created elsewhere. And, amazingly, you can search the text of a .PDF file and create hyperlinks from one object to another within a file. Heavy-duty compression also makes Acrobat a great way to disseminate and archive graphical files on a LAN, eliminating the need for reams of paper copies.

• List price: *Acrobat, (pricing not available at press time); Adobe Systems Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039; 800-833-6687, 415-961-4400; fax, 415-961-3769.*

Circle 404 on reader service card

NEW

Dell's New Server Design Keeps a Pentium Chip Cool

Dell Computer Corp.'s new 4000/XE Server Series includes the 60-MHz, Pentium-based 4560/XE with a list price of $5,550 for 8MB of RAM and a 320MB IDE hard disk (a VGA monitor is available separately for $199). The entire line of EISA-based tower servers feature Dell's new Thermal Management System (TMS), which keeps high-performance components (such as the Pentium processor) cool by using four thermostatically controlled fans to drive air through isolated chambers. Dell has announced that it will offer a Pentium upgrade board for the rest of the 4000/XE line as well as for the installed base of Dell PowerLine 486/SE server and 486/DE desktop systems.

• List price: *Dell 4033/XE Server, $4,150; 4050/XE, $4,350; 4066/XE, $4,550; 4560/XE, $5,550. Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759-7299; 800-289-3355, 512-338-4400; fax, 512-794-4238.*

Circle 406 on reader service card

NEW

New Vendor Unveils Windows Desktop and Workgroup Manager

How do you keep a new desktop manager from being just another face in the crowd? If you're upstart vendor **Computer Knacks,** you simultaneously release a workgroup manager to manage multivendor networks with device independence. Habitat for Windows is a stand-alone desktop manager for building a custom work environment that either replaces or augments Program Manager. It can launch multiple applications in a single operation; locate files using Alias names (up to 31 characters long), text strings, and wildcards; and automatically size, fit, and arrange on-screen objects.

Habitat for Workgroups lets administrators change desktop configurations, streamline application upgrades, move server volumes, and provide workgroup support from a central location without complicated drive mappings. It's compatible with all networks that support Windows and operates so that global changes to

Photography by Thom O'Connor

the network will not impact users.
• List price: *Habitat for Windows, $99.95; Habitat for Workgroups, $349 for 10 users. Computer Knacks Inc., 621 Shrewsbury Ave., Suite 12-B, Shrewsbury, NJ 07702; 800-551-1433, 908-530-0262; fax, 908-741-0972.*
Circle 408 on reader service card

NEW

Portfolio Hopes the Paperless Office Never Comes to Pass

In this electronic age, paper hasn't disappeared. Daily planners thrive alongside PCs, so **Portfolio Software** is shipping DynoPage for Windows, Version 1.0, which combines a printer driver with an application that lets you print any file on any size paper in order to generate small pages for appointment books, calendars, and personal organizers. You can set up DynoPage to work transparently within your Windows applications (it also includes a handy uninstall feature if you wish to remove the program), and it gives you over 200 layouts to choose from, including double-sided pages and thumbnail proofs.

DynoPage for Windows' printer driver lets you print the way you want to.

• List price: *DynoPage for Windows, Version 1.0, $89.95. Portfolio Software Inc., 10062 Miller Ave., Cupertino, CA 95014-3471; 408-252-0420; fax, 408-252-0440.*
Circle 411 on reader service card

NEW

IBM Ships Object-Oriented Tools for Programming C++

Building on the success of its C Set/2, **IBM Corp.** has announced IBM C Set++ for OS/2, a new suite of object-oriented tools to help C++ developers create 32-bit OS/2 applications. The Set comes with prepackaged objects that can be tailored to specific applications and an extensive collection of C++ class libraries, including IBM-unique classes such as the Presentation Manager User Interface library for developing PM applications without in-depth knowledge of PM. In addition, IBM C Set++ for OS/2 has precompiled headers, a visual trace analysis tool, a graphical C++ browser, a visual PM debugger, and a graphical user interface-based integrated development environment. Users of IBM's C Set/2 or Workset/2 can upgrade for $145.
• List price: *IBM C Set++ for OS/2, $175. IBM Corp., Programming Systems Business Unit, Bldg. 1, Rte. 100, Box 100, Somers, NY 10589; 800-342-6672.*
Circle 409 on reader service card

BRIEFS

CD-ROMs

Aris Entertainment has released three new CD-ROM titles devoted to nature. Tropical Rainforest ($39.95) features 100 color images, 100 audio clips of Andean pan flute music, and 25 live-action video clips. Deep Voyage ($39.95) has 100 underwater images, 100 audio clips, and 25 video clips. Full Bloom ($39.95) includes 100 classical piano clips and 25 video clips of flowers blooming in time-lapse photography and even morphing. 310-821-0234.

EduQuest, an IBM company, is distributing two CD-ROMs covering African–American history. Lessons From History: A Celebration of Blackness, and The African–American Experience: A History ($129 each) were produced by Computerized Educational Resources and use IBM's LinkWay and LinkWay Live!. 800-758-4663.

From **Moon Valley Software** comes ROMaterial ($29.95), a CD-ROM that combines some of the best icons for the vendors' software collections, Icon Do-It and Icon Hear-It, with an array of elaborate screen savers, wallpapers, animated icons, and sound bites, including personality voices and foreign-language words. 800-473-5509, 602-375-9502.

HARDWARE

The time is coming for **PCubid Computer Technology**'s new Pentium CPU Kooler ($39.95), a heat sink plus miniature fan that will come in handy when systems are upgraded to the Pentium chip in a ZIF or similar socket. The Kooler includes a temperature probe that lets you add Radio Shack's Digital Thermometer. 916-338-1338

Acculogic is shipping HomePort/CD ($799), a portable CD-ROM drive that plugs into the parallel port of any PC, using a standard printer cable. The drive's subsystem is built around SCSI bus technology to provide better multimedia performance in a plug-and-play design. 800-234-7811, 714-454-2441.

New to the multimedia market, **InMotion** is shipping Picture Perfect, a 24-bit RGB live-motion video and frame grabber card that's capable of displaying

IMPROVED

Logitech's MouseMan Cordless Feels Even Better than Before

You may not think your mouse is uncomfortable to use, but **Logitech** is improving ergonomics anyway. The new version of the MouseMan Cordless fits the shape of your palm and lets your fingers rest naturally, but since control is as important as comfort, the ball has been moved forward to improve pointing accuracy. Logitech's MouseWare software lets you program the other two mouse buttons with shortcut commands. The MouseMan Cordless uses radio wave rather than infrared technology, so the receiver picks up mouse signals from up to 6 feet away, even through obstacles.
• List price: *Logitech MouseMan Cordless, $149. Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; 800-231-7717, 510-795-8500; fax, 510-792-8901.*
Circle 410 on reader service card

IMPROVED

Out with Lauded Phaser IISD, In with Faster Phaser IISDX

Tektronix has decided that being a finalist for a 1992 *PC Magazine* Technical Excellence Award wasn't good enough for its Phaser IISD dye sublimation color printer, so it's replaced that model with the Phaser IISDX. The new printer delivers faster image processing while maintaining PostScript Level 2 and networking capabilities, and it boasts enhanced TekColor color-matching algorithms that make it suitable for pre-film color proofing.

The Phaser IISDX comes with a Phaser Print plug-in driver for accelerated printing with Adobe Photoshop. Registered Phaser IISD owners can receive an upgrade kit for $195; the kit is free for Phaser IISD printers

AMAX 486DX2/50 ISAmax Power Station

PC MAGAZINE EDITORS' CHOICE

February 23, 1993

Amax 486DX2/50 ISAmax

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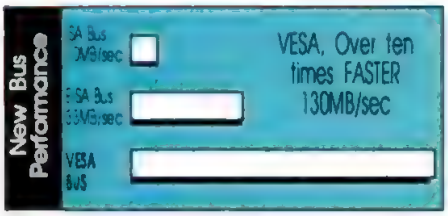

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"THE END OF THE PAPER CHASE" Reg. T.M. Micro Dynamics, Ltd., Silver Springs, MD

purchased after April 1, 1993. The Photoshop plug-in driver can be downloaded free from Tektronix's bulletin board.

• List price: *Tektronix Phaser IISDX, $9,995. Tektronix Inc., P.O. Box 1000, MS-63-583, Wilsonville, OR 97070; 800-835-6100, 503-682-7377; fax, 503-682-7450.*

Circle 412 on reader service card

NEW

Covox Delivers Voice Control to DOS, Windows Applications

Voice recognition is hot, and **Covox** has recently fortified its place in the market with a software program that gives you voice control over your applications. Covox's Voice Blaster runs under DOS and Windows with Sound Blaster–compatible sound boards, providing over 1,000 voice commands that you can use with popular business software and games. Additional utilities let you record, edit, and play back sound files and annotate documents with recorded messages. Voice Blaster comes with a headset that includes a microphone and speaker and attaches to the parallel port (though it will also work with most installed PC microphones).

• List price: *Voice Blaster, $119.95. Covox Inc., 675 Conger St., Eugene, OR 97402; 503-342-1271; fax, 503-342-1283.*

Circle 413 on reader service card

IMPROVED

ImageFast Enhances Features, Price of Document Management

Version 1.2 of **ImageFast Software Systems**' Windows-based document imaging and management software, ImageFast, is a full-featured product at a bargain price. The $195 standalone version has three modes of optical character recognition (OCR), including a mode that reads only the fields in a scanned document that you specify with the cursor. It also has full-text indexing and searching capabilities and a transfer function that lets you move data and objects to ODBC (Open Database Connectivity) databases. The product's Removable Media Mapper tracks the physical location of data on any type of removable media, and the Jukebox Platter Mapper organizes optical cartridge sides into one volume and eliminates fragmentation.

A multiuser version of ImageFast comes with WorkFast software, which uses a database metaphor rather than an e-mail metaphor for document routing and workflow management.

BRIEFS

HARDWARE

16.7 million colors in real time. It supports Super VGA, local-bus, and Windows accelerator cards and can simultaneously display two live-motion videos. 510-651-2626

Cardinal Technologies has announced two new 16-bit sound cards, the Digital Sound Pro 16 ($159) and the Digital Sound Pro 16 Plus ($229), based on a reprogrammable digital signal processor chip set so you can easily upgrade your PC sound system with new software features. Both cards come with a variety of Voyetra programs, including Annotator, AudioStation, and Windows Jukebox. 717-293-3000

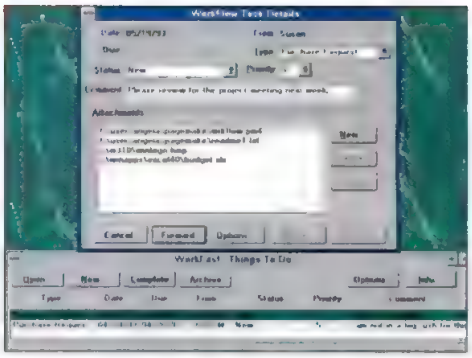
Hewlett-Packard Co.'s new Model C1716T 5.25-inch optical disk drive ($3,950) gives you 1.3GB of storage on a single disk. The drive can read and write to the 650MB media and is jukebox-ready. It will become a part of HP's line of jukeboxes later this year. 800-826-4111.

SOFTWARE

Traveling Software is shipping LapLink V for NetWare ($499.95 for five users) with all the features of NetWare V plus peer-to-peer file transfer capabilities. 206-483-8088

Help-desk software vendor **Clarify** has announced Version 2.0 of ClearSupport (about $6,000 per concurrent user), its technical support management system, and ClearQuality (about $4,000 per concurrent user), its defect tracking system. Enhancements to the two modules include new ways of tracking and reporting (Trends, December 22, 1992) 408-428-2000

Midisoft Corp., makers of 1992 *PC Magazine* Technical Excellence Award finalist Midisoft Studio for Windows, is shipping what it calls a music edutainment program for the family called Midisoft MusicMagic for Windows ($49.95) With MusicMagic you explore and experiment with music without any instruments through features like the Score View utility, which lets you play, arrange, and write your own or previously programmed MIDI song files. 206-881-7176.



The multiuser version of ImageFast has powerful workflow management features.

• List price: *ImageFast, Version 1.2, $195; $9,855 for 10 users. ImageFast Software Systems Inc., 7926 Jones Branch Dr., #260, McLean, VA 22102; 800-899-6665, 703-893-1934; fax, 703-893-7499.*

Circle 414 on reader service card

NEW

Data Race Hits Ground Running: New Modems, LAN Adapters

You may not know the name **Data Race,** but the modems that they've sold to PC manufacturers over the years may be in more than one of your systems. Now the modem supplier is entering the retail chain with its RediCard series of PCMCIA Type 2 modems and Ethernet LAN adapters, as well as its RediModem series of internal ISA modems for Compaq, IBM, and Toshiba portable computers. The RediCard series includes three data/fax modems: the RC-1496, with 14,400-bps data/9,600-bps fax capabilities; the RC-9696, with 9,600-bps data/9,600-bps fax capabilities; and the RC-2496, with 2,400-bps data/9,600-bps fax capabilities. (All have built-in error correction and data compression.) The two LAN adapters in the RediCard series are the RC-10B2, a 10Base2 adapter, and the RC-10BT, a 10BaseT adapter.

The RediModems fit in Compaq's Contura and Lite notebooks, the IBM ThinkPad 700 and 700C, and most Toshiba laptops and notebooks. They're available in 14,400-bps data/9,600-bps fax and 9,600-bps data/9,600-bps fax models.

• List price: *RediCard RC-1496, $595; RC-9696, $529; RC-2496, $399; RC-10B2, $399; RC-10BT, $399; RediModem, $595 (14,400/9,600 models); $529 (9,600/9,600 models). Data Race Inc., 11550 IH-10 West, #395, San Antonio, TX 78230; 800-749-7223, 210-558-1900; fax, 210-558-1929.*

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NEW

QMS Ships New 4-ppm, 600-dpi PostScript Printer

The new **QMS** 420 Print System performs at 4 pages per minute and 600 dots per inch in PostScript Level 1 and 2, PCL 4, and HPGL emulations. Since the parallel, serial, and LocalTalk interfaces are simultaneously active, the 420 will fit in mixed environments, and, using QMS's Emulation Sensing Processor, the printer can analyze incoming print data and switch to the appropriate language mode. The system comes standard with 39 resident, scalable Type 1 fonts and a 70-sheet input tray. An optional font card with 26 more typefaces costs $249, and an optional 250-sheet feeder costs $195.

• List price: *QMS 420 Print System, $1,995. QMS Inc., One Magnum Pass, Mobile, AL 36689-1250; 800-523-2696, 205-633-4300; fax, 205-633-4866.*

Circle 416 on reader service card

NEW

WinInstall Sends Applications As E-Mail Attachments

Not only does **Aleph Takoma Systems**' WinInstall, Version 3.0, control installations and upgrades of Windows applications across any network, but it can do it using electronic mail. An administrator creates a mailable .DAT file, specifying an installation, upgrade, or even removal; it then sends the file as an attachment to an e-mail message so that, when the recipient double-clicks on the attachment, the process of installation, upgrade, or removal begins automatically.

• List price: *WinInstall, Version 3.0, $495 per server (unlimited users). Aleph Takoma Systems Inc., 7319 Willow Ave., Takoma Park, MD 20912; 301-270-4458; fax, 301-270-6710.*

Circle 419 on reader service card

NEW

TimeWise Manages Everything: Contacts, Money, and Projects

David Berman Developments' new TimeWise for DOS (distributed by **Dynamic Software Solutions**) combines contact management, financial management, and project management with a graphical interface to give small- to medium-size businesses all the tools needed to manage daily operations. With TimeWise you can track clients, build estimates and schedules, design proposals, monitor jobs and their deadlines, perform order entry and billing, print shipping labels, and more. It's network-compatible with six levels of security, and it even has an electronic noticeboard for posting workgroup-wide meetings and news. There are even built-in routines for self-diagnosis and self-correction of data, plus archive, backup, and purge routines. If you need a full-featured accounting solution, TimeWise provides links to the SBT Accounting Library. A two-month trial license is available for $49, and licenses for concurrent users vary.

• List price: *TimeWise for DOS, $795. Dynamic Software Solutions Inc., 177 Telegraph Rd, #447, Bellingham, WA 98226; 800-795-9074, 206-671-7331; fax, 206-671-7689.*

Circle 417 on reader service card

BRIEFS

SOFTWARE

The new version of **Microsoft Corp.**'s Microsoft Office for Windows ($949) includes the company's relational database management system, Microsoft Access. The suite of programs also includes Microsoft Excel, Microsoft Mail, Microsoft PowerPoint, and Microsoft Word. The original Office for Windows, without Access, is still available for $750. 800-426-9400, 206-882-8080

Add-in publisher **Intex Solutions** is shipping Verbose ($95), an add-in thesaurus specifically for Lotus 1-2-3. Verbose has synonyms for over 90,000 words and currently supports all DOS and Windows versions of 1-2-3. Intex is also offering Verbose bundled with its add-in spellchecker, Spellin!, for $145. 617-449-6222.

RYBS Electronics is shipping Version 8.17 of its ATLast! upper memory optimizer ($79.95) with full support for MS-DOS 6.0. ATLast! enhances the performance of your current memory manager. 303-444-6073.

Digital Soup has announced a voice-recognition software program for Windows called Rover ($129). The Rover package comes with a 50-word command dictionary that can be customized with your own voice commands, which can be application-specific. A sound board and a microphone are required. 800-793-7356, 802-254-7356

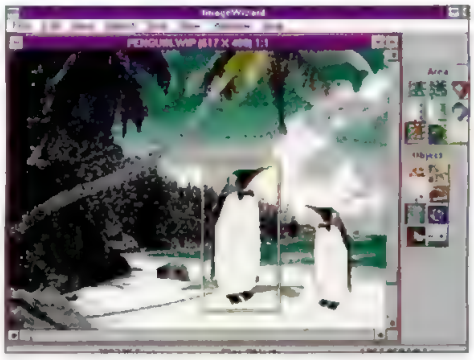
Clarion Software Corp. is shipping Version 3.0 of Clarion Database Developer ($995) with visual prototyping tools, mixed graphics and text support, and an automatic overlay system. Clarion's TopSpeed compiler technology removes the performance penalty of 4GLs. 800-354-5444, 305-785-4555.

Version 2.0 of **Jensen Jones**'s personal information manager, Commence ($395), features network support, drag-and-drop scheduling, four-level password security, enhanced dynamic data exchange (DDE) links, and more. 908-530-4666

NEW

With ImageWizard, Image Editing Means Image Building

ImageWare Software's new ImageWizard, Version 1.0 lets you create multiple objects in an image and then perform a variety of operations on them, such as distort, flip, posterize, recolor, resize, and rotate. The program's object-oriented approach to image editing means now you can *assemble* bitmapped images, clip art, photo CD images, and slides from a variety of editing sessions. You can even combine objects, backgrounds, and images of different resolutions. ImageWizard supports OLE (Object Linking and Embedding) and a wide array of file formats and comes with an on-line multimedia user guide with animation, audio, and video.



With ImageWizard 1.0 you define objects in your image files and edit them separately.

• List price: *ImageWizard, Version 1.0, $199. ImageWare Software Inc., 4330 La Jolla Village Dr. #270, San Diego, CA 92122; 619-457-8600; fax, 619-457-8290.*

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i486 SX 33MHz SYSTEM

$1,749

FEATURES:

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- 230MB (17ms) HARD DRIVE
- UPGRADEABLE PROCESSOR
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- ***LOCAL BUS VIDEO***
- ULTRA VGA 1024NI MONITOR (14", 1024 x 768, .28mm, NI)
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- 512KB VIDEO RAM
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DELL DIMENSION 486/33
i486 DX 33MHz SYSTEM

$1,899

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[1]Test results obtained by Dell Performance Measurement Lab by running BAPCO SYSmark92, and WINBENCH version 3.11 at 800 x 600, 256 colors. System tested: 486/50 configured with 4MB RAM, 170MB IDE HD, , promotions not available in Canada [2]Leasing arranged by Leasing Group, Inc [3]On-site service provided by BancTec Service Corporation. On-site service may not be available in certain remote locations. MS-DOS and Microsoft trademark of Intel Corporation. Dell disclaims proprietary interest in the marks and names of others. ©1993 Dell Computer Corporation. All rights reserved.

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- ***INTERNAL CD ROM***
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- ***1MB VIDEO RAM***
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- DUAL DISKETTE DRIVES (3.5" AND 5.25")
- 1 AVAILABLE EXTERNAL 5.25" HALF-HEIGHT DRIVE BAY
- 5 AVAILABLE 16-BIT EXPANSION SLOTS
- 2 SERIAL PORTS, 1 PARALLEL PORT, 1 MOUSE PORT
- 200-WATT POWER SUPPLY
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- 2 SERIAL PORTS, 1 PARALLEL PORT, 1 MOUSE PORT
- 200-WATT POWER SUPPLY
- MS-DOS 6.0/MICROSOFT WINDOWS 3.1/MOUSE

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DELL DIMENSION 486/66
i486 DX2 66MHz SYSTEM

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FEATURES:

- BUSINESS LEASE: $115/MO.
- 16MB RAM (EXPANDABLE TO 64MB)
- 450MB (12ms) HARD DRIVE
- UPGRADEABLE PROCESSOR
- 128KB EXTERNAL CACHE
- ***INTERNAL CD ROM***
- ***ACCELERATED LOCAL BUS VIDEO***
- ***1MB VIDEO RAM***
- ULTRASCAN 15FS MONITOR (15", 1024 x 768, .28mm, NI)
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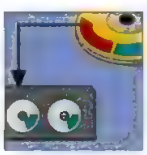

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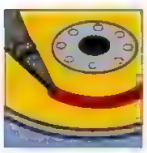

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CIRCLE 117 ON READER SERVICE CARD

Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

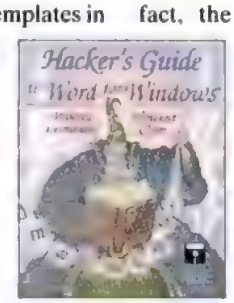
Edited by Carol Levin

Everything Microsoft Didn't Tell You About WordBasic

BY BRENT HESLOP AND DAVID ANGELL

Just below the surface of Word for Windows (WinWord) is a built-in programming language called WordBasic. WinWord commands are actually macros created using WordBasic. Anyone can dive into WordBasic to modify macros or create their own, but Microsoft's limited support of WordBasic, along with the stigma associated with programming, may have kept you from discovering this simple-to-use, powerful customization tool. Here are two guides that will help you take control of WinWord.

Guy Gallo, one of the authors of Microsoft's WordBasic user manual, takes a friendly approach to teaching WordBasic in *Take Word for Windows to the Edge*. His explanations of macros, styles, and templates in the context of WinWord's overall design are the best we've read. He teaches WordBasic programming fundamentals in plain English and supports them with a number of clearly written examples and solutions.



Most of the macro examples improve on WinWord's own commands. You'll learn how to write macros to arrange documents side by side, reformat ASCII files, create an icon for a document, and much more. The book comes with a disk that contains over 50 macros (most of which are used as examples in the text) and with ready-to-run templates for resumes, scripts, and plays.

Although not every WordBasic command is covered (WinWord's table commands, for example), *Take Word for Windows to the Edge* is, without a doubt, the best guide to learning how to program in WordBasic. Period.

In another WordBasic guide, authors Woody Leonhard and Vincent Chen are the offbeat denizens of the WinWord world. Their approach to WinWord is zany, unorthodox, and irreverent. Leonhard and Chen explain WinWord not the way the manual and most WinWord books say it should work, but the way it really works. In fact, the authors admit *The Hacker's Guide to Word for Windows* is really an "*Undocumented WinWord* in wolf's clothing."

The Hacker's Guide does assume some familiarity with programming and WordBasic. Because WinWord commands are made up of WordBasic macros, it makes sense that over 70 percent of the book covers WordBasic. The authors document bugs and anomalies that exist in WinWord and offer serious solutions. Especially entertaining are the anecdotes of their trials in finding solutions to WinWord's bugs. Some of the idiosyncrasies they uncover include "phont phunnies" (bugs in WinWord that, without warning, change your text to a different font); slow printing; deletions of text when using revision marks and hidden text; and problems with file conversions.

Bundled with *The Hacker's Guide* is the Word for Windows Office Power Pack (WOPR) program disk, which by itself sells for more than the book. WOPR includes a Toolbar editor; Enveloper, a program for printing envelopes and bar codes on any printer; 2x4 (a macro for printing two to four pages on a single page); and a wide assortment of WordBasic macros. *The Hacker's Guide* is the ultimate compilation of what Microsoft didn't tell us about Word for Windows. □

Take Word for Windows to the Edge, *by Guy Gallo, $29.95 Ziff-Davis Press; 800-688-0448. ISBN: 1-56276-079-3. Circle 462 on reader service card*

Hacker's Guide to Word for Windows, *by Woody Leonhard and Vincent Chen, $39.95. Addison-Wesley Publishing Co.; 800-447-2226. ISBN: 0-201-63273-X. Circle 463 on reader service card*

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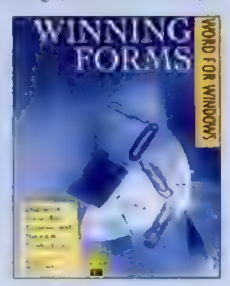
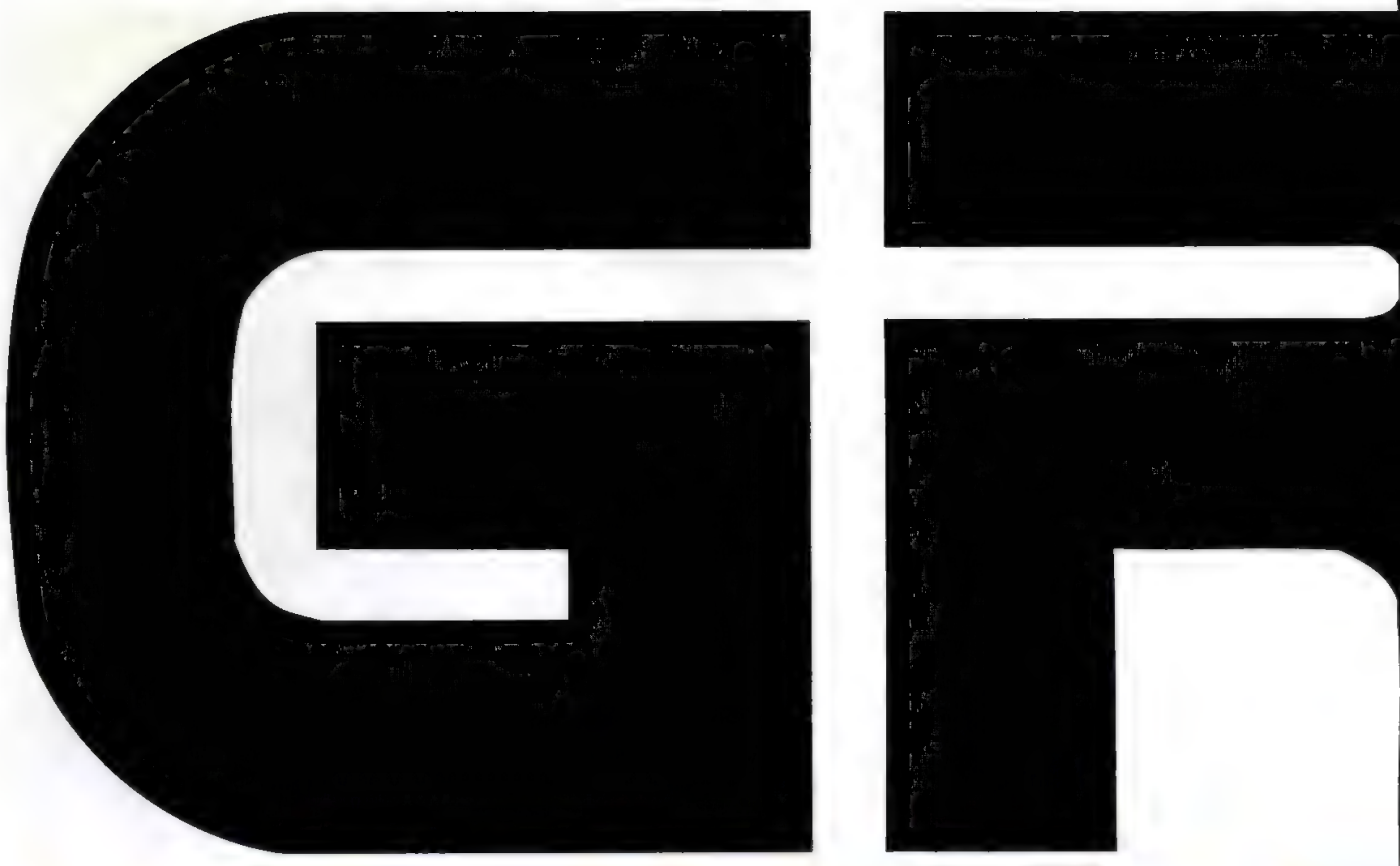
If you use Word for Windows but don't want to take the WordBasic plunge, *Winning Forms* will help you design good-looking documents in a fraction of the time you'd spend creating them on your own. This book/disk package from Random House Electronic Publishing (800-733-3000) delivers a stylish collection of over 100 premade templates. Any type of form stocked at an office supply store is included as a Word for Windows document template file. You'll find templates for mailing labels, invoices, purchase orders, expense reports, and dozens of other business and personal documents such as business cards, resumes, press releases, and newsletters.



So you can easily preview each template, *Winning Forms* includes a sample of each design and offers more than one format for most forms. You'll learn how to customize any form template with your own logo by working with WinWord's field and table features.

The *Winning Forms* series also includes books for Lotus 1-2-3, Excel for Windows, Quattro Pro, WordPerfect for DOS, and WordPerfect for Windows. While the price is a little steep at $45 each, *Winning Forms* is sure to make your documents look professional and save you hours of design and template-building time.—*BH and DA*



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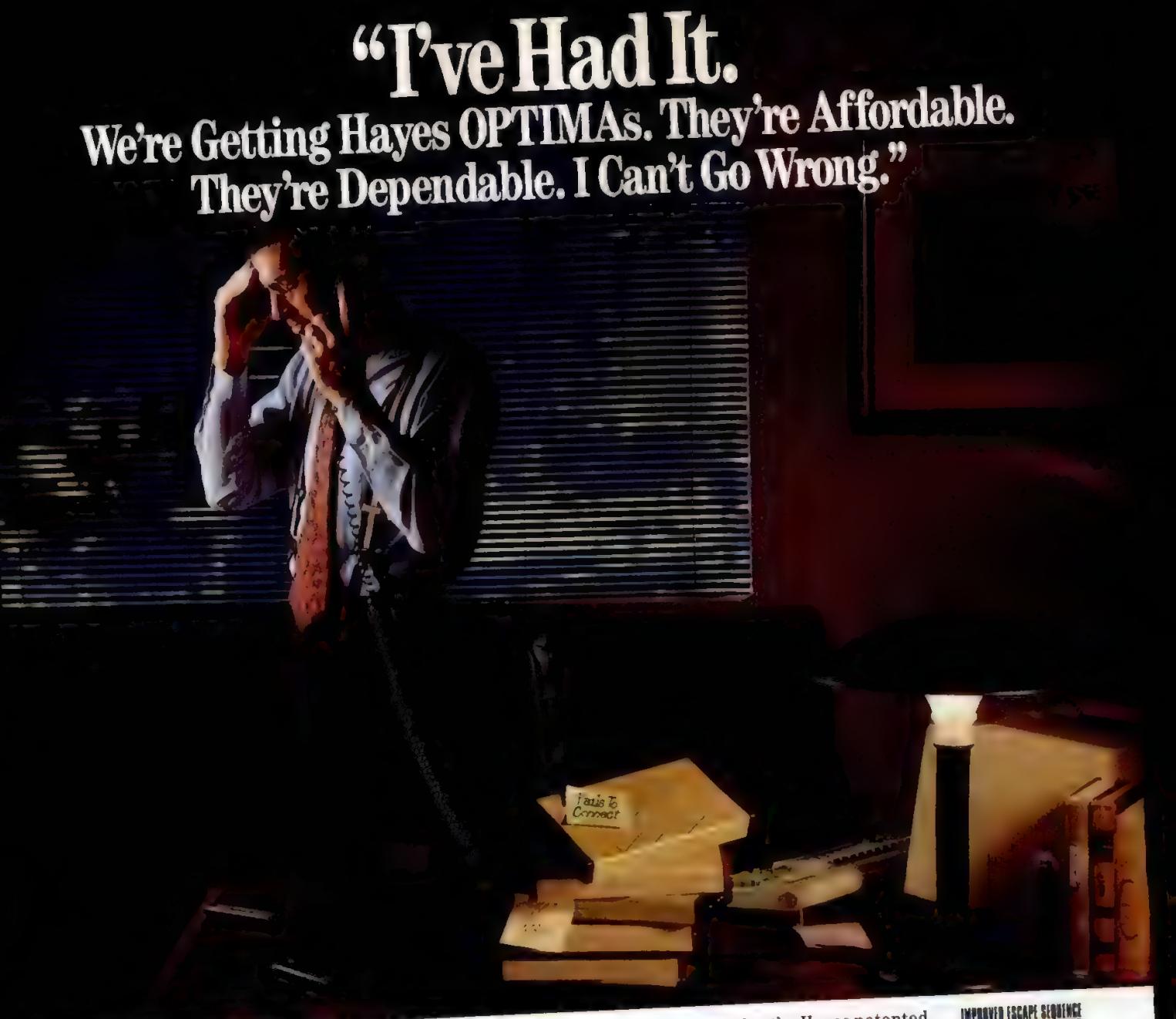

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CIRCLE 136 ON READER SERVICE CARD

Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

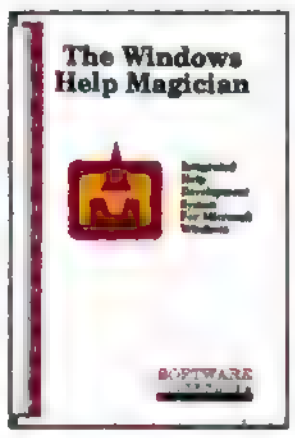
Edited by Trudy Neuhaus

Create Help Files Quickly With The Help Magician

BY NEIL J. RUBENKING

The job isn't finished until the paperwork is done—or, if you're a Windows programmer, until the help system is done. After working hard to develop an application, most programmers dread creating the associated help file. The Windows Help Magician, Version 1.35, from Software Interphase, is a speedy integrated help development system that brings ease and order to this arduous task.

The standard method for building a Windows help file begins with the creation of a Rich Text Format (RTF) document. However, only a few word processors can produce RTF files correctly formatted for the Microsoft help compiler. In addition, you have to use a peculiar system of footnotes and codes to identify keywords, context strings, jumps, pop-ups, and so on. If you make a mistake, you won't know it until you feed the RTF document to the DOS-based help compiler.



By contrast, The Help Magician handles every step of the process *and* lets you test your help system as you go. It's based on a simple text editor with added abilities specific to creating help files. The Help Magician depends heavily on special paired *markers* that affect the text between them. Markers identify bitmap filenames, jumps, and pop-ups, as well as font changes, indentation, and bulleted lists. In the editor, they're displayed as open rectangles or vertical lines, depending on the font you've chosen to work in.

Because these markers are so important, the editor protects them and keeps them balanced. It prevents you from accidentally deleting a lone marker—you have to choose the Marker | Delete function. When you cut and paste text, markers are stripped out, and you can't cut or delete an area containing just *one* of a pair of markers. The status line indicates the active marker for the text at the cursor, along with the font name, size, and color. After typing the text for each topic, you simply fill in the title and any keywords. If you don't specify a context number or context string, Help Magician will automatically assign unique values. Press a button to create and reorder browse lists with ease.

The Help Magician's editor is *not* WYSIWYG. For example, bitmaps appear as marked filenames, and font changes aren't visible on the screen. However, a test mode lets you simulate the action of the compiled help system. In test mode, when the cursor is on a bitmap, you can view that bitmap by pressing a button; when it's on a jump or pop-up, you can jump to the destination by pressing another button. Browse buttons are activated if the current topic is part of a browse list, and the standard Windows help buttons, Contents, Search, Back, and History are fully functional. You can completely test the functionality of your help system, which is more important than seeing its final appearance.

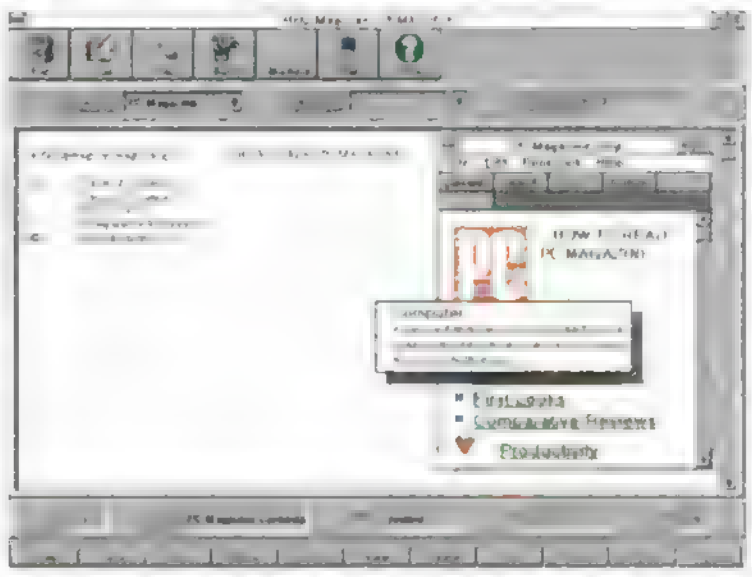


Figure 1: **In this help system created with The Windows Help Magician, the C in the *PC Magazine* logo is assigned to a pop-up definition of "computer."**

When the help system is complete, select Build All from the Build menu and The Help Magician will double-check the system's syntax, save the RTF file, and then invoke the help compiler. The Help Magician captures messages from the help compiler and displays them for your perusal, but error messages are rare because of the built-in syntax checking. After the .HLP file is built, another menu choice loads it into the Windows help system, and you get your first look at the finished product.

You can save the help system as a text file, complete with header information that identifies topics, keywords, and other information. This text file could form the first draft of the product's manual, with the keywords serving as index topics. You can also print the help text, the browse lists, and a list of all jumps and pop-ups. The Help Magician will import ASCII and RTF files too, though it's necessary to format ASCII text to indicate page breaks.

The Help Magician is compatible with the Windows 3.0 or 3.1 help compiler. However, the only new 3.1 help feature supported is segmented hypergraphics (hotspots) in bitmaps. You have to use the Windows SDK's SHED.EXE hotspot editor to create hotspots, and you must manually maintain consistency between the context strings in The Help Magician and SHED. Version 2.0, expected by this July, should include full support for Windows 3.1 help features such as help macros and secondary windows.

The Help Magician has a few limits such as 60 pop-ups per page and 15 keywords per page. The only limit that might cramp your style is the maximum of 512 topics and 1MB of text. The next version will support 32,767 topics (the help compiler's limit) and unlimited text.

Designing help systems with The Help Magician is so easy that you might even want to use it as a hypertext authoring tool, independent of providing help for a product. Certainly for Windows programmers it's indispensable. □

• The Windows Help Magician, Version 1.35
List price: *$199 (site license available).* Requires: *1MB RAM, Microsoft Windows 3.0 or 3.1, Windows help compiler.*
Software Interphase Inc., 82 Cucumber Hill Rd., # 113, Foster, RI 02825; 800-542-2742,401-397-2340.
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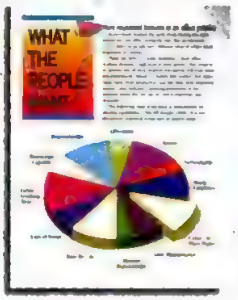

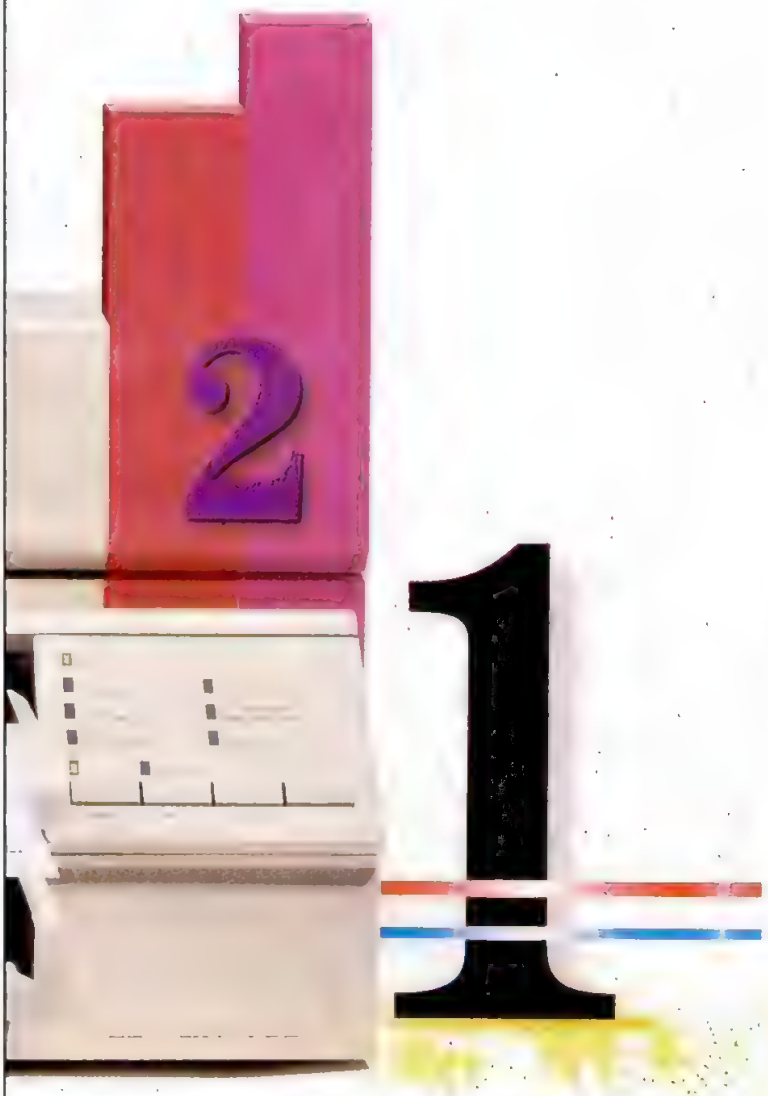

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CIRCLE 162 ON READER SERVICE CARD

Michael J. Miller

No Computer Is an Island

Groupware is one of those trendy buzzwords that the computer industry loves to use, though no one seems to know what it means. Everyone agrees that it has something to do with working together over a network, yet few people would call multiuser databases and electronic mail programs (the most typical networked applications) by themselves groupware. So what is groupware? In my opinion, groupware combines—and extends—the concept of a shared group of information (a database) with a method for moving data between users (e-mail).

So does that make Lotus Notes groupware? Lotus Notes probably fits the term's broad definition because it does combine database and mail-transport functions. How about Windows for Workgroups? Probably not, because while it includes a mail engine, the operating environment itself doesn't provide much in the way of a shared store of information that users can access.

In either case, however, the individual product isn't all that important. What can really change the way we work are applications that take advantage of the groupware concept and enable us to truly work together. Yes, databases of information count, but I'm more interested in extending the kind of applications we all run constantly—specifically, word processing and spreadsheets—in ways that will allow *collaboration.*

We're beginning to see this happen now in spreadsheets applications. Take, for instance, the new Lotus 1-2-3 for Windows, Release 4, which can use features in Notes to allow a level of collaboration that spreadsheets didn't have in the past. The new Lotus 1-2-3 includes Version Manager, which builds on the Chronicle technology that Lotus has been showing for the past couple of years. Chronicle took a long time to come to market, but it's certainly a big step forward.

Version Manager lets you define a range that has multiple, different sets of values. Each set of values is then called a version. For instance, you might have a named range called "Estimated Sales" and you might name three different versions "High Sales," "Medium Sales," and "Low Sales." Another range could have estimates for expenses or costs of goods. You can then combine multiple versions (such as a series of estimates) to create a scenario, a named group of versions. It's an easy way to keep track of different estimates or different information within the same spreadsheet. It's much more convenient than having multiple spreadsheets with names such as 93a.wk3, 93b.wk3, 93c.wk3, and so on. Lots of people have such spreadsheets, and versions can help eliminate them.

By itself, this is not new. Though Lotus showed this idea first, Microsoft implemented it first in the scenario manager that shipped in Excel, Version 4.0. But Excel limits you to working with one range at a time and is nowhere near as complete as the implementation in 1-2-3. For instance, the Lotus product lets you store style information (such as different colors) and use formulas in the cells that change. It also lets you store notes about each scenario, making it easier for others to understand why you created each version.

Potentially, the more important change comes when you use Version Manager in conjunction with Notes. Then several users can make comments, or enter or edit versions or scenarios at the same time. The program notifies the user of any changes and flags new and unread versions. In short, Version Manager lets groups of people work together on a spreadsheet at the same time.

When it comes to providing features that really foster collaboration, today's apps only scratch the surface.

You can expect Microsoft and Borland to compete on this ground as well. Still, version management is just one way in which spreadsheet designers are beginning to deal with the fact that spread-

Illustration by Harvey Chan

sheets involve input from many different people.

For instance, we're seeing approaches that take the same basic information and look at it in different ways, which is often necessary when creating reports for different people. This is perhaps most visible in programs such as Lotus Improv, which lets you rearrange rows and columns easily. While Lotus offers this in a program separate from its flagship spreadsheet, other vendors are thinking of ways in which to combine the two. Computer Associates' Compete offers another way of moving or pivoting the rows and columns as part of a more traditional spreadsheet, though it hasn't been so easy to use. Sinper's TM/1 Perspectives extends an existing spreadsheet to pull information in multiple views out of a database in different views, working as an add-in for Excel and earlier versions of 1-2-3 for Windows. Others plan to integrate Improv-like pivoting in their more traditional spreadsheets.

We're also seeing better ways of consolidation and new ways of dealing with multiple-sheet spreadsheets (such as the introduction of tabs to name each sheet in Quattro Pro for Windows, a concept Lotus has also adopted in 1-2-3, Release 4). We're seeing spreadsheets extended to become OLE (Object Linking and Embedding) clients and servers, allowing them to work better with other applications. Additionally, spreadsheets are being better connected to mail applications, though this is still more limited than one would like. (For instance, Lotus's spreadsheets currently work fine with Lotus's e-mail packages, but not with others.)

All this is a big step forward for spreadsheet users who work on their spreadsheets with other people—in other words, most spreadsheet users. So far, though, we've just begun moving toward collaboration.

Still, we've come a lot farther in spreadsheets than we have in categories such as word processing and desktop publishing. We have seen a few glimmers of recognition concerning the way documents can be created by more than one user in these programs, but not many. Most word processors have a simple redlining or document-comparing feature, but these have yet to be well integrated with e-mail systems. There's rarely a way of controlling versions, of seeing who made what changes, or of easily allowing more than one person to make annotations.

Desktop publishing is even more maddening. Publications are nearly always put together by groups of people, and those working on them would like to be able to know who has what story or piece of art, who made what changes and when, and so on. We have seen a few commercial applications that start down this path (mainly on the Macintosh), and a lot of companies have worked on custom solutions. But the general-purpose group-publishing features still haven't lived up to the potential of today's networks.

From spreadsheets to word processing to desktop publishing, the potential for using computers to help people work together is enormous. So far, we've barely scratched the surface. The time has come for us to begin asking software developers for more features designed to help people work together. After all, the fact remains that in today's networked world, no computer is an island. □

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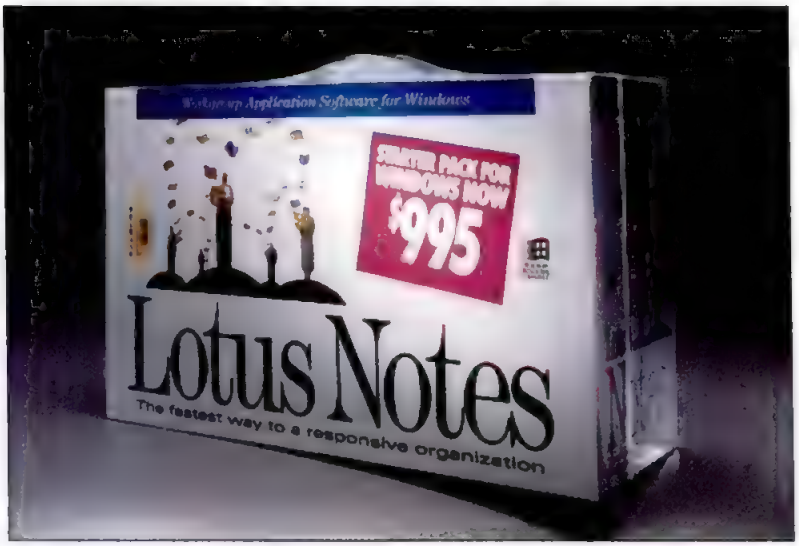

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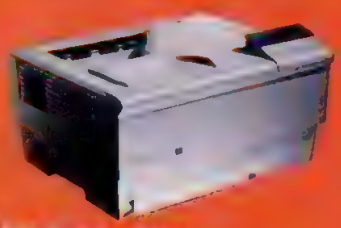

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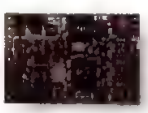

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Bill Machrone

The Pentium Panic

I swore to myself that I wouldn't write this column. Then I saw the opinions being voiced by some of my fellow columnists and I had no choice. From the reception they're giving the Pentium, you'd think it was the silicon equivalent of cod liver oil.

The Selective Thinking troops are out in force, and I think I understand why. After all, we've been reaping the benefits of cutthroat competition among system builders. A thousand bucks for a 486 system? Who'd have thought it a year ago? Nobody wants these low prices to go away, and the Pentium can only drive up prices of top-of-the-line machines. Also, nobody wants their new 486 desktop gem to be eclipsed, much less outclassed. The Pentium blows away the 486 in performance and makes it look like what it is: last year's CPU.

So the pundits of paralysis have come up with a few ostensibly convincing arguments as to why you should ignore the Pentium:

1. The Pentium doesn't replace the 486. This argument is my favorite. It avers that them durned computers are already so fast that most users would hardly know if there were a Pentium inside the box. I, for one, am not "most users," and neither are you. A Pentium in your system is as obvious as a tarantula on your keyboard. The corollary to this one is that the benefits of a Pentium processor are more likely to be realized in a server, not in a desktop. Yeah, sure. My only question is, who'll be first to introduce a Pentium-based notebook?

Sure, Pentium-based servers will be faster, but the real bottleneck is I/O, not the processor. The desktop is where the action is: number of units, applications, graphics, and real demand for CPU performance.

2. It just doesn't matter. Like Bill Murray and his hapless charges in *Meatballs*, some folks think that if they go in with a defeatist attitude, they won't be disappointed. They realize that Pentiums will be in short supply for most of this year. Since they're expensive and you can't get them anyway, why get yourself all stirred up? This attitude ignores the unfortunate reality that developers, as always, will get the newest technology first, they'll build their software on it, and it'll rapidly become the standard against which all performance is measured.

3. The Intel Conspiracy. This is the one where Intel cynically holds back Pentium production as long as possible in order to milk 486 profits for all they're worth. I could almost see this one if Intel had really thought that it would be able to maintain a monopoly on 486 production. It kept AMD out of the game for a while, but it couldn't keep Cyrix out because of the cross-licensing arrangements with chip foundries. Besides, second sources are good for the industry. The lead company sets the pace of technology at the high end, and the licensees set the price on the low end. Second sources also typically produce variants that are too small a market for the lead company to address.

It's inarguably true that Intel delayed the introduction of the Pentium chip and that delivery has been slow. Intel clearly needed the time to improve yields. What's wrong with that? After sinking hundreds of millions of dollars into designing the thing, Intel is certainly entitled to maximize profit. By the same token, hardware manufacturers needed the time to deal with the Pentium's speed. The 66-MHz bus speeds present a whole new set of challenges to the motherboard designers, while the Pentium's superscalar speeds have elevated cache design from a job to an adventure. Every additional day that the manufacturers didn't get chips from Intel was another day they had to debug and perfect their machines.

The 486 isn't dead, but the handwriting is on the wall. Here we go again.

Illustration by Harvey Chan

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CIRCLE 008 ON READER SERVICE CARD

Bill Machrone

Believe me, they needed it.

4. Software portability will make the Pentium immaterial. Windows NT, Taligent, OS/2, and Unix are all multiplatform or headed that way. This portability scenario could happen in our lifetimes, but not in this century. You'll be able to buy a portable OS soon, only to wait for the little details such as performance, portable development tools, and backward-compatibility to be worked out. Or, as with every other innovation in this business, the developers can leave the installed base twisting in the wind.

DIMINISHING RETURNS

I've also seen some claims in the press that future OverDrive-like technologies will give us inexpensive upgrades that will match the Pentium in performance. Baloney. Clock doubling was a good idea because it filled up unused bus cycles. Some I/O-intensive tasks, however, are faster on a 486/50 than a DX2/66 because the 50-MHz motherboard handles off-chip functions more quickly than the 33-MHz motherboard that supports the DX2/66. IBM already has a clock tripler, and you can expect to see one from Intel soon. A 100-MHz 486 will be nothing to sneeze at, but it'll be waiting on that 33-MHz motherboard a lot more often than a Pentium with a 66-MHz motherboard.

Desktop demand for CPU utilization is "bursty." This means you can be out of your office the better part of the day, while the CPU blows off a hundred billion instructions per hour, waiting for you to do something. Then you return to the office and run a Video for Windows clip. Suddenly, your power-to-burn 486/33 is reduced to gibbering idiocy as it tries to cope with the onslaught of bits from your hard disk and a torturous decompression algorithm, all while blasting pixels to your screen. There's no way to level the resource, to save up those CPU cycles for a rainy day. To run state-of-the-art applications you need state-of-the-art hardware. It's got to be there for you when you need it.

So is it worth it? You can buy that 486/33 today for a thousand bucks, or you can kick in another couple of grand and get a Pentium system that goes twice as fast. One of them is about as high as a building oughta go and the other one is the stairway to heaven.

See you at those pearly gates. □

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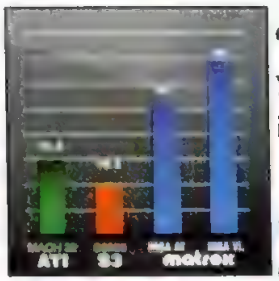

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John C. Dvorak

Interface Addiction and War

It's officially known as Acquired Pattern Addiction (APA), but you may know it as Interface Addiction, an incredible cult-like fanaticism that afflicts Windows, OS/2, and Unix hacks. We should have been tipped off to the mental health dangers of interfaces back when the addiction craze started with the Mac and Amiga hysteria. Once habituated, people go beyond rationality if forced even to consider withdrawal. Like a pathetic drunk, the user of one of these machines wants everyone else to use them too. Anyone who doesn't is considered a fool. But this is not rational behavior. Why should I care if you use Unix, Windows, or OS/2?

Vendors are just beginning to understand the phenomenon. It's no coincidence that Louis Gerstner was installed at IBM. Remember, he used to run a tobacco company. The key to success is finding ways to get users to cross over from one addictive interface to another—a marketing challenge that's poorly understood.

As all these operating systems adopt each other's features, what difference does it make which one you choose? And why do people fight so vehemently over which is best? Interface Addiction.

The phenomenon is clearly observable and something of an epidemic. Many of you recall the craziness that surrounded the WordStar diamond and the Lotus backslash. Once you learn to use these keys, you're addicted. I believe that if you derive enough gratification from constant use of a command set, then a true addiction occurs. It's not unusual for people to get angry, indeed traumatized, without these keys. I, for example, have strong feelings toward both the WordStar diamond and the PC-Talk command set.

This simple theory of Interface Addiction can even explain why Mac users have been fanatics about their computers all along. They received positive feedback from habitual use and enough gratification to develop an addiction. Seventy-five percent of all Macs sold today are sold to previous owners. Now we're starting to see the same zeal with Windows and OS/2 users.

With a command-line interface, the likelihood of this occurring was negligible, since the interface functionality didn't come at the operating system level. Acquired behavior occurs within the application and is varied enough to minimize the addictive effect.

I also feel strongly that addictive features should not be protected by patents or copyrights. At the point where a command set becomes addictive, it should become public domain. Protecting it is like allowing only one tobacco company to use nicotine in its cigarettes.

With a GUI operating system, the interface is so rigid that a broad addiction is bound to occur. Look at the enormous number of messages on CompuServe over this issue. You'd think a war was going on, with each side defending its addiction as the *best* addiction.

So while people argue functionality, performance, and application availability, they're all missing the point. The idea is to get you addicted and keep you in the fold. It won't matter whether NT is a dog or not, as long as it works and adheres to the Windows interface. For OS/2 to succeed, it must dump the Windows interface model (Win-OS/2) and install a PM-type interface that runs Windows programs.

When vendors figure out what's going on, you can expect interfaces to be ported from OS to OS, not from chip to chip: PM running over Windows, Windows over Unix and the Mac, Motif over DOS. It's a battle we can expect in the future—kind of like a turf war among drug dealers.

Do you fit the profile of the classic interface addict? Better check yourself for symptoms before it's too late.

Illustration by Harvey Chan

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CIRCLE 234 ON READER SERVICE CARD

John C. Dvorak

Inside Track

Chip Wars, the Next Generation. So now that AMD retrieved its **legal right** to sell its 486 using Intel microcode, we can expect all hell to break loose in the chip business. Of course, AMD will continue work on the "clean room" version of the chip in case it loses its rights again. The "clean room" version is coded by people who, for legal reasons, have no connection to Intel and have not seen the original microcode. **Rumor** has it that the microcode is being developed by **Chips and Technologies** and may be available to other cloners.

It's now clear that Louis Gerstner, the new CEO of IBM, won't bust up the company. You have to wonder if IBM may even recapture some spin-offs. I've been baffled by IBM's choices of what to get rid of.

The Plot Thickens at IBM Dept.: It's now clear that Louis Gerstner, the new CEO at IBM, will not bust up the company as former CEO John Akers wanted to do. So you have to wonder if IBM will actually do the opposite and recapture some spin-offs. Lexmark comes to mind. I've been baffled by IBM's choices of what to keep and what to get rid of. The tendency was to get rid of the future.

My befuddlement goes back to the IBM Product Centers that were sold to Nynex. The original theory, which was to control the channels and offer a complete solution, was good thinking. But because of the bureaucratic bumbling, empire building, **butt-covering and petty bickering** throughout IBM, costs of operations soared.

Apparently—at least until now—the only way IBM was going to maintain a lifetime employment policy and a men's club atmosphere was to sell off the future. How is it that the printer company could only survive *outside* the bureaucracy? **Pretty pathetic.**

Other Frightening Considerations Dept.: Remember that Akers was at IBM for 33 years. The skill he learned best was how to get to the top in 33 years. Let's face it. To do it that way there had to be a lot of strange alliances and favors exchanged. The bad news is that he's not the only guy with decades of IBM tenure. What are they thinking? **Many of the old-timers know they can't get a job on the outside.** They've been promoted into positions that **do not exist** outside of IBM. They'll be asking "Do you want fries with that?" and **wearing a beanie** if they try and get a job in the real world. This is the problem with working for decades at one large firm that does things its own way (an old-fashioned way, it seems).

The few who knew they could survive outside IBM **quit** when the retirement **incentives** were strong. The rest stayed. But what do they do now that a new CEO is **grinding up** the place? They find ways to move competent people from unassailable jobs and place themselves in these positions. So instead of having a **well-paying do-nothing job**, they put themselves in a position where they have to actually work. When the job survey people come along they eliminate the do-nothing job and keep the real job. Unfortunately the do-nothing guy is in the real job. I have been told by insiders at IBM that this process is now underway and **job switching** and musical chairs is in full swing.

The result is that some of the dead wood will actually perform well and flourish, **but most won't** and they will actually make Gerstner's job harder than it should be. What's Gerstner supposed to do? Analyze 300,000 employees individually? We can expect it to **take longer to turn IBM around** than one might expect from Gerstner. Don't expect miracles.

Meanwhile, IBM is serious about making microprocessors a profit center. Look for its own version of the 486. There are two clock-tripled versions due out. One willl run at 75 MHz and the other, **dubbed Blue Thunder**, at 99 MHz. IBM will produce both chips and VESA/ISA motherboards containing them for sale to OEMs. None of this sits too well with Intel, so IBM is allegedly going to **loan Intel a fabrication plant** to give it the breathing room it needs to make some Pentium chips at its newest facilities.

While on the subject of Intel Dept.: Boy was I wrong when I said there were **one million 486 chips a month** being manufactured. Intel says it will ship **30 million** this year! Who is buying all these computers! Add to that 486s from Cyrix and AMD. That means someone is buying **one 486-based PC every second**, 24 hours a day every day of the year. We have to find this person and stop him!

Genuinely Interesting Fonts Dept.: I see a lot of fonts and until now only Adobe has impressed me with its kerning and hinting. So I was **stunned** by the fonts in infiniType Plus. Softmaker Inc. has gone to the extra expense of licensing the great fonts and hinting them **better** than any non-Adobe fonts I've seen running on the PC platform, period. **These are the fonts I use** on my PC. The selection is outstanding. Included in the $99.95 Infinitype Plus box are 124 TrueType fonts, 124 PostScript fonts, a scaling engine and 80 special effects! Zowie! Call 619-929-6030, 619-929-6034 (fax) and get them. You won't regret it. □

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i486DX	✔	
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FEATURES	COMPUDYNE Subnote	DELL 320SLi	ZEOS Contender	ZDS E-Lite	GATEWAY Handbook
CPU	i486SL	i386SL	i386SL	i386SL	C&T286
Weight (lbs)	3.6	3.5	4	3.9	3.25
Removable Hard Drive	Yes	No	No	No	No
RAM standard and maximum	4/20	4/10	4/10	2/4	2/5
PCMCIA Type II Slot	Yes	Yes	No	Yes	No
Built-in VGA Display	Yes	No	Yes	Yes	No (CGA)
Battery Life	4	3	3	3.5	4
Integrated Trackball	Yes	No	Yes	No	No
Full-size, Full-Travel Keyboard	Yes	Yes	No	Yes	No
DOS/Windows/ Organizer	Yes	No	Yes	No	No
Price	$1999	$1799	$1795	$1899	$1295

- Internal expansion compartment for optional memory upgrades or FAX/data modem saves the PCMCIA slot for other uses.
- External 3.5", 1.44 MB floppy drive.
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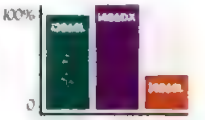
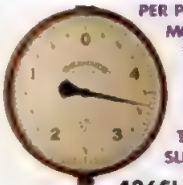


CPU Power Consumption (Lower power consumption for longer battery life)



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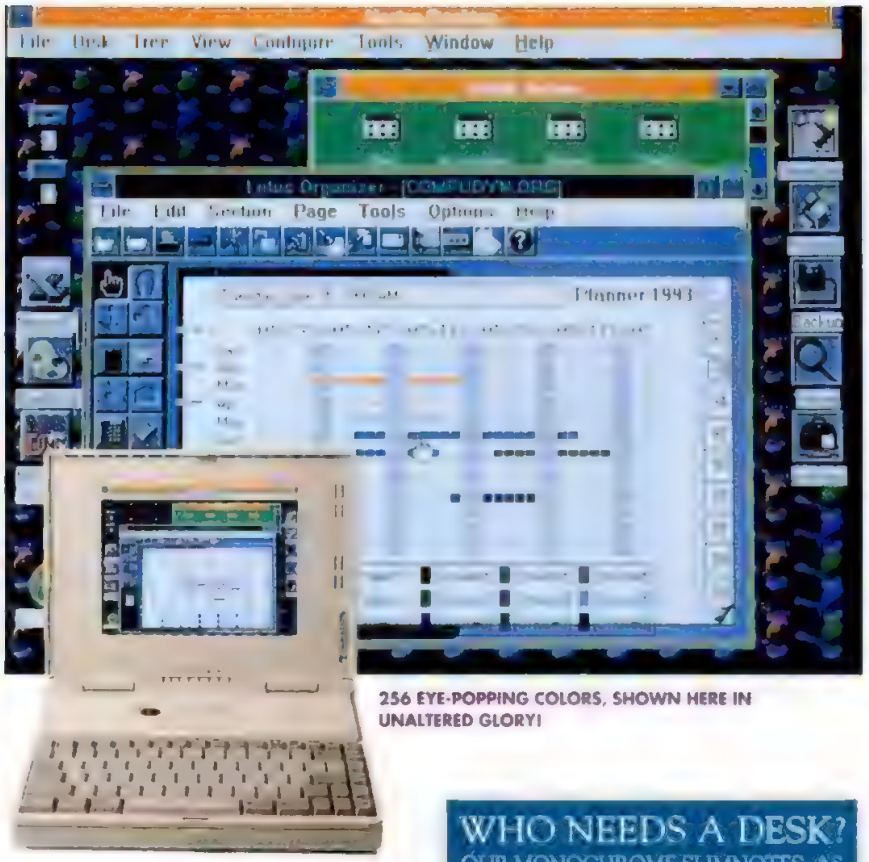

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CIRCLE 144 ON READER SERVICE CARD

WE ACCEPT THE HONOR...

PC MAGAZINE EDITORS' CHOICE

March 16, 1993
ADI MicroScan 3E+

"Their smooth digital controls include all the basics and more... adjust for advanced features such as pincushioning and trapezoidal distortion. Another plus is that saving up to 10 settings is easy ... In Short: The ADI MicroScan 3E+ offers digital controls, digital memory, and a maximum noninterlaced resolution of 1,024-by-768 at 72 Hz, which adds a little style to a 14-inch monitor"

MicroScan Model Name	2E	3E	3E+	3G	4G	5A
CRT Size	14	14	14	14	15/17	17
Dot Pitch (mm)	0.28	0.28	0.28	0.28	0.28	0.26
Active Display Size (mm) *	267x200	267x200	267x200	267x200	306x230	326x245
H Frequency (KHz)	30-38	30-58	30-58	30-64	30-64	30-71
Vertical Scanning (Hz)	50-100	50-100	50-100	50-100	50-100	50-100
VESA 640x480@72Hz	●	●	●	●	●	●
VESA 800x600@56, 60, 72Hz		●	●	●	●	●
VESA 1024x768@60Hz		●	●	●	●	●
VESA 1024x768@70, 72Hz			●	●	●	●
1280x1024@60Hz				●	●	●
WYSIWYG Color				●	●	●
Manual Degauss						●
Universal (90-264 VAC)	●	●	●	●	●	●
Two Year Limited Warranty	●	●	●	●	●	●

* Depends on Video Card Used

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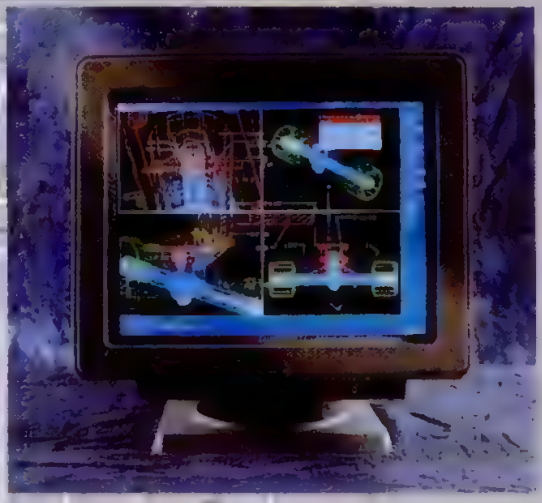

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CIRCLE 226 ON READER SERVICE CARD

Jim Seymour

Not *All* PC Prices Are Falling

If any business defies the traditional laws of economics, it must be the PC business. Or maybe it's just that there's a special Subsection J, Part 21M, Paragraph 724(c)/7 that applies to PC hardware and software, and they didn't pass out that part of the code back when I was in college.

The last year and a half has been free-fall time. Hardware prices fell by more than half while demand was rising, new features and technology were being added, and distribution channels were expanding. At the same time, there was a significant shortage of product, mainly due to component shortages. (Just ask Compaq or Gateway about component-availability problems.)

That's not how it's supposed to work. When demand is high, products are being substantially improved, and supply can't keep up with demand, prices are supposed to remain stable or rise.

Or so they said in Econ 301.

The fall from grace in software was less visible but no less profound as the competitive-upgrade and software-suite revolutions cut real prices by two-thirds. While demand for Windows applications was going through the roof, actual street prices fell sharply. Ditto on how things are supposed to work.

In both cases, the incredible hypercompetitiveness of the PC marketplace drove prices down. Being priced out of the market was a greater danger, suppliers decided, than cutting prices deeply and watching margins collapse. This may not be traditional economics, but you and I sure benefited from the suspension of How It's Supposed To Work.

Now, though, we're seeing some PC vendors playing risky games with prices: pushing their prices up at a time when serious competition is upon them. Two examples of flying in the face of the New Laws of PC Economics come from Intel and Novell.

Intel seems to think the Pentium chip has the advanced-PCs market just about sewn up. Granted, the chip is good; and granted, Intel did a superb job of building public relations hysteria about the chip before the first Pentium PCs shipped on May 17. But it's not *that* good, and it's not without serious challengers.

In a hypercompetitive PC market, Novell and Intel have chosen dangerous pricing strategies.

TWICE THE POWER OR HALF THE PRICE

Competing chips such as Digital Equipment Corp.'s Alpha, Silicon Graphics' R4000 and R4400, and maybe the IBM/Motorola/Apple PowerPC chip, too, offer you a choice of about twice the performance for the same price Intel's charging for the Pentium, or Pentium-level performance for half Intel's price.

Intel can't be unaware of this, but the company isn't eager to talk about it, either. That's because the answer is a bit unseemly: Intel's using value pricing in the "we'll charge whatever we can get away with" sense, since it has decided that Pentium's compatibility with the hundred million *x*86 chips out there means we'll pay what they demand to dance to their tune.

That was a safe bet when the operating system everyone cared about, DOS, didn't run on anything other than *x*86 designs. We don't buy PCs for their chips (or for their operating systems, for that matter), but for access to the applications we want. The *x*86 architecture, DOS, and, later, Windows gave us that access, so *x*86 was the way to go.

But with Microsoft Windows NT running on the Alpha and R4000/R4400 processors and on the Power PC platform in the near future, it's no longer an Intel-controlled world. Intel-dominated, yes; Intel-controlled, no.

Intel certainly isn't going to price itself out of the market in an absolute sense—Pentium chips are already in huge demand—

Illustration by Harvey Chan

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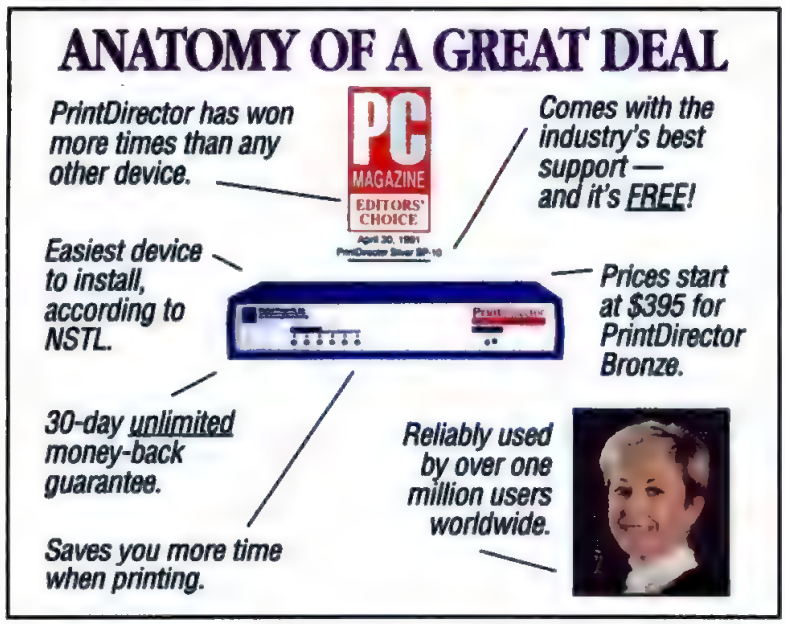
*PrintDirector Gold Turbo printed nearly five times faster than Novell Lite, almost 2 1/2 times faster than ASP Port Authority, about twice as fast as ESI Share Spool and Buffalo SLmkII, and 40% faster than Lantastic. *Based on printing an output file created with Harvard Graphics. Total time for three PCs to print concurrently to two printers.*

ANATOMY OF A GREAT DEAL



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CIRCLE 002 ON READER SERVICE CARD

Jim Seymour

but the company could lose a critical chunk of business with this kind of pirate-ship pricing.

Novell is working the same side of the street with its prices for NetWare 4.0. Sure, NetWare 4.0 delivers what customers have been asking for, especially the ability to access and manage disparate, far-flung LANs as if they were in the same room. NetWare 4.0 unarguably delivers greater value than any previous version.

But bringing up 4.0 is going to be a struggle: Forget most of what you know about NetWare 2.*x* and 3.*x* when you start, please. And with many companies just taming NetWare 3.*x*, moving to 4.0 is hardly a no-brainer.

So what does Novell do? Jack up the price of NetWare 4.0 to 25 percent more than NetWare 3.*x*. Nice going. Nothing like putting a needless impediment in the way of an already-difficult buying decision, Novell.

Even worse, just as Intel has come under siege from other foundries with hot chips and an operating-system route to success, Novell is also facing a serious threat: the Windows NT onslaught. No one thinks NetWare is going to disappear, but a great many network managers I know think Windows NT is going to grab a big share of the market over the next few years.

If NT delivers on its promises—and the last betas make that a good bet—it's a serious long-term threat to Novell's dominance of PC networking, including Novell's newfound interest in the Unix market.

And Microsoft is bringing Windows NT to market with licenses priced far lower than Novell's.

The last year and a half have taught us many lessons about the pricing dynamics of the PC marketplace. Ultimately, the same forces affect microprocessors and network operating systems that affect PCs and their applications.

Yet Intel's and Novell's pricing strategies for their new products are right out of Detroit, not Silicon Valley: Every new model-year, the prices go up.

Maybe both can succeed here; their huge installed bases and substantial momentum count for a lot, even when the rest of the PC world seems to be going in the opposite direction.

But both are playing risky games at an awfully risky time. □

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CIRCLE 353 ON READER SERVICE CARD

Bill Howard

Don't Bank On It—Yet

If ever there were tasks crying out for computerization, tipping the scales in favor of buying a PC for a home or small business, they are checkbook-balancing and bill-paying. What a great idea. What a half-fast implementation. You see, the more the technology improves, the more necessary an infinite series of improvements seem. Both Intuit and MECA Software may appear to be running out of ways to improve their programs Quicken and Managing Your Money. But this is hardly the case. In fact, it's all getting so complex that the more you use their electronic bill-paying links, the more you wonder if you shouldn't take another look at paper.

With electronic bill paying, you send payment information by modem from your personal finance program to a service (CheckFree is the largest). The service makes an electronic funds transfer (EFT) to some merchants and prints and mails paper checks to others. It's $9.95 a month for 20 transactions. But while bank-to-bank transactions are superfast, individual transfers are slow. Charles Keating, for example, could probably zap $8.54 million from Eldorado Thrift to Credit Suisse du Caribe. But if I sit down to pay my bills electronically on the first of the month, my $854 Visa payment still won't arrive until the eighth. If it arrives at all.

Department stores and banks sometimes change your account number if, say, you lose your card. They also move their mailing addresses in their search for favorable tax laws. So you must scan each statement to watch for changes and update the electronic payee list. If your payment goes to your old account number, it probably won't be forwarded to the new one. You'll be charged a failure-to-pay fee, and your card may be rejected the next time it's used. A call to the card issuer might straighten things out, but electronic personal finance should provide fewer hassles—not different ones.

The idea that you can pay bills once a month is a reach, too. Often, your credit card bills fall due within two weeks of arrival, and if you include the five-to seven-day lead times needed for electronic payments, you may have to pay your bills three times a month.

Hassles notwithstanding, I've been happy enough with PC-based finance to use it for seven years, and happy enough to use electronic payments for more than two years. And I see three current and future trends that make me more optimistic:

The IntelliCharge Visa card linked to Quicken includes a monthly summary, mailed by disk or downloaded, that automatically categorizes all your expenditures—usually correctly. Once, it categorized my store purchases as "Legal and Professional Fees." The good news is that I only had to correct it once.

This summer, MasterCard and CheckFree will jointly offer a PC-based bill-paying service, MasterBanking, that promises to cut the lead time for the electronic check payments to one or two days. Also, you can authorize vendors to apply directly to MasterBanking for automatic payment of their bills. That means you could go away on a long vacation and not worry. Intuit is working on a similar deal with Visa. You can fine-tune payments with a Touch-tone phone.

Managing personal finances on the PC is a great idea, but will it save you time and hassles?

For writing checks in public, Panasonic's new check printing accountant, KX-RC100, provides a handy electronic organizer, a check register, *and* a check printer—all in a 1-pound package. With an optional cable, it can update the Quicken account on your PC. But like other personal digital assistants, it carries sticker shock, listing for $350 and selling for $250—twice as much as it should be. Just like the $1,000 Apple Newton PDA. □

Illustration by Harvey Chan

Cover Story

The PERFECT PC

By Michael J. Miller

WHAT IS THE PERFECT PC? IT ALL DEPENDS ON WHOM YOU ASK AND HOW YOU LOOK AT THE QUESTION. THE SIMPLE ANSWER IS THAT WHILE THERE ARE a multitude of PCs that will perform many different tasks satisfactorily, there is no PC that is perfect for everyone. In this special issue, we walk you through the decision-making process in order to help you choose the computing system that is perfect for you.

To do this, we look at the components that make up a personal computer: the main system unit, the video display subsystem, the hard disk and other storage devices, and the accessories, such as keyboards and mice. Because these devices are meaningless on their own, we put together four prototype Perfect PCs, each suited for a different pace and style of computing.

These include an ideal but rather expensive dream machine, a typical Microsoft Windows workstation, a good starter system for small offices, and a network server. These systems serve as examples of the kinds of components you should be looking at in choosing a new system.

Your Perfect PC may be the one that is already on your desk. Maybe it just needs a little updating: The hard disk might be getting a bit crowded, or your video display may

seem to drag, or perhaps the original CPU is not as swift as you'd like. To help you remedy these shortcomings, we look at how to upgrade portions of your system, and we review the best upgrades available for graphics adapters and hard disks.

Of course, even the Perfect PC will someday fail. So we examine diagnostic software designed to keep your system up and running at full speed, and we give you hints on how to keep your network working smoothly as well.

In addition, you will find a rundown of the service policies of the major hardware and software makers, followed by the results of our most recent poll of PC Service and Reliability, in which we report our readers' experiences with the reliability, repair service, and technical support of the leading makers of desktop and laptop computers. And we add our annual look at Software Support and Satisfaction, so you'll know how other readers rate the software that they run on their Perfect PCs.

Above all, we hope that the features, reports, and other elements we have included in this issue will serve as guides for selecting, maintaining, and upgrading your PC. We know that real perfection is embodied in a system that meets your specific needs. The Perfect PC is simply the one that is right for you.

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Photograph by Christopher Gould

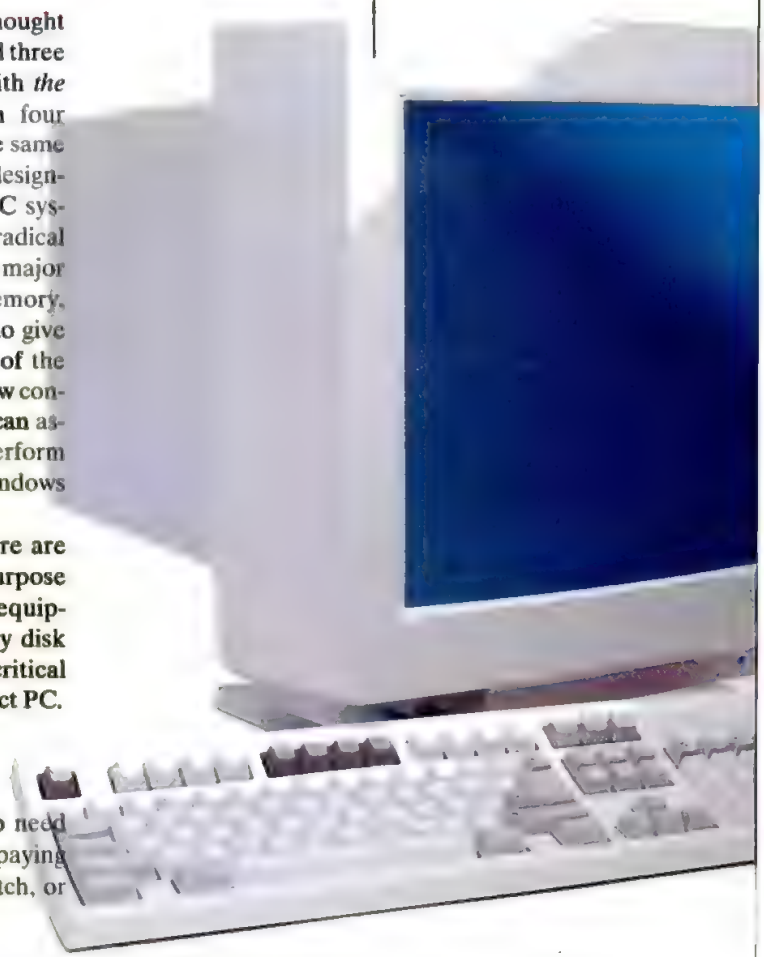
FOUR PATHS *to* PERFECT

MORE THAN A CASUAL MIX OF COMPONENTS IN A GRAY BOX, THE PC IS A TOOL SUITED TO A PARTICULAR FUNCTION. CHOOSING THE RIGHT PARTS MAKES ALL THE DIFFERENCE.

BY BRIAN NADEL

There's a saying that such a divergence of thought exists among economists that if you locked three in a room and told them to come up with *the* perfect theory, you'd come away with four theories. Chances are that if you tried the same exercise with three personal computer designers, you'd come away with four ideal PC systems—each. There aren't any new and radical ideas about how to combine a system's major components—microprocessor, system memory, disk drive, video adapter and monitor—to give breakthrough performance. The beauty of the PC platform lies in its flexibility. With a few configuration changes, the personal computer format can assume a range of personalities: The same box can perform equally well as a high-powered dream machine, Windows workstation, office system, or network server.

As a result there is no single perfect PC. There are several, each optimized and tuned for a specific purpose and aimed at a target audience. Beyond the basic equipment—a mouse, a keyboard, and a pair of floppy disk drives—the choice of individual components is a critical element to getting the computer that is *your* perfect PC.



Display
20-inch multiscanning monitor

THE ULTIMATE DREAM MACHINE: NO-HOLDS-BARRED COMPUTING

Our dream machine is aimed at a select few who need the ultimate level of power available and can justify paying for it. Like a red Porsche, Patek Philippe wristwatch, or

ION

Case
Full tower

Processor
Pentium

External cache
512K

Video adapter
1,280-by-1,024 resolution, 2MB of VRAM, 24-bit color capability

Mass storage
1GB SCSI-2 hard disk with 4MB hardware disk cache

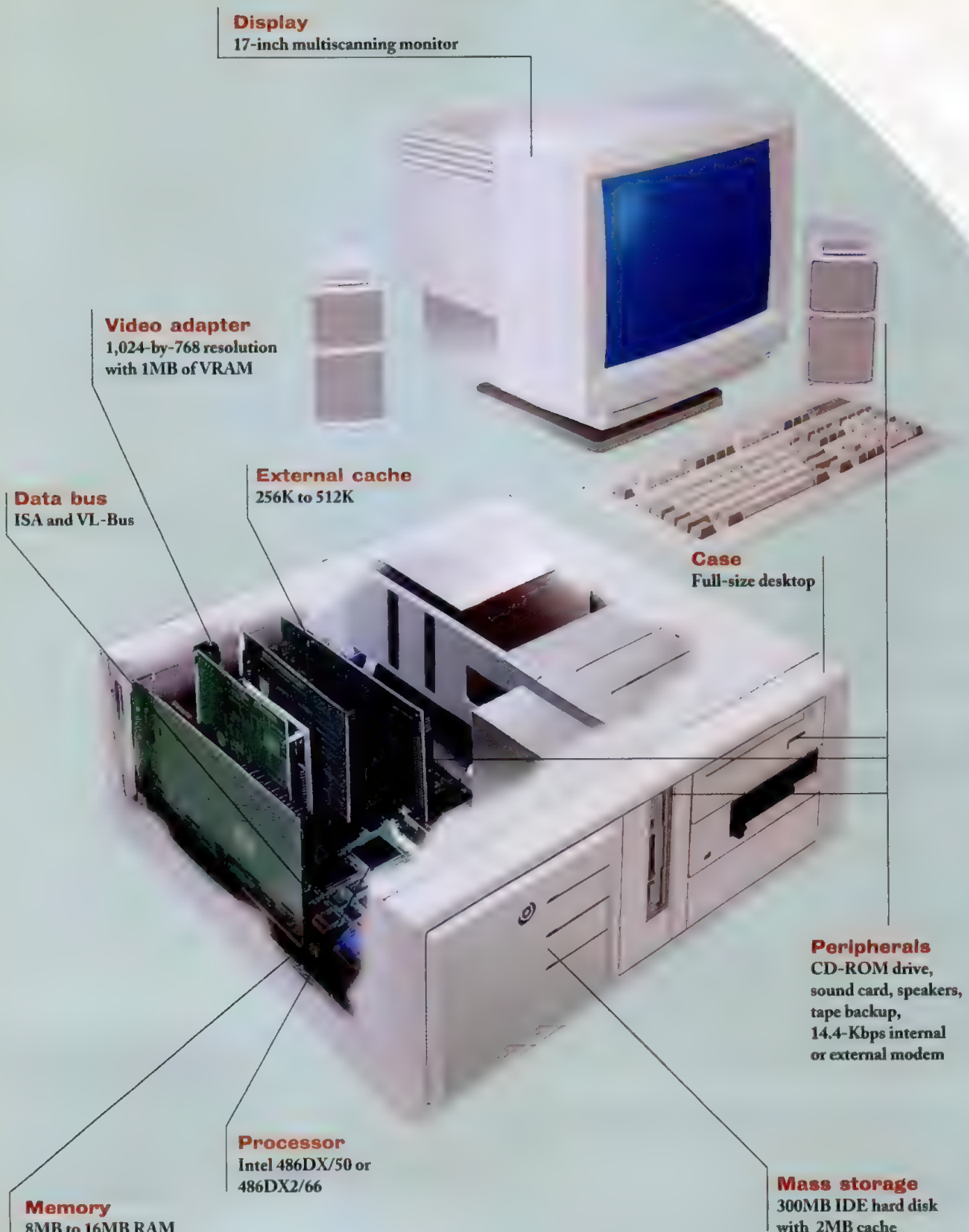
Data bus
EISA with VL-Bus or MCA

Memory
32MB RAM

Peripherals
Rewritable magneto-optical drive, CD-ROM drive, sound card, high-quality speakers, 14.4-Kbps external or internal modem

1. The Dream Machine

Price:


Display
17-inch multiscanning monitor
Video adapter
1,024-by-768 resolution
with 1MB of VRAM
External cache
256K to 512K
Data bus
ISA and VL-Bus
Case
Full-size desktop
Peripherals
CD-ROM drive,
sound card, speakers,
tape backup,
14.4-Kbps internal
or external modem
Processor
Intel 486DX/50 or
486DX2/66
Memory
8MB to 16MB RAM
Mass storage
300MB IDE hard disk
with 2MB cache

original Picasso, the dream PC is an item that we lust after but rarely buy. More than being the best that today's technology has to offer, the dream machine provides a standard for judging more mundane PCs. The dream machine's audience will be CAD artists, software developers, financial analysts, and power users who require the best computer available. These power-hungry PC users live in a graphics- and computing-intensive world dominated by advanced operating systems like Windows NT and OS/2.

It should come as no surprise that the dream machine starts with the fastest and most capable microprocessor on the market: the Pentium. The choice is whether to spend the extra cash on getting Intel's full-bore 66-MHz version or to use the more sedate though potent 60-MHz CPU. In an attempt to bolster the chip's 16K of internal cache and to keep this data-hungry CPU operating smoothly, the system will be equipped with 512K of external cache and 32MB of system RAM. To satisfy the demands of today's disk-intensive applications, mass storage will be handled by a 1GB SCSI-2 hard disk with 4MB of hardware disk cache. In lab tests, we've found that a properly tuned software caching program and hardware cache can boost throughput significantly.

A rewritable magneto-optical drive will provide quick and seamless data backup. While we'd like to use one that is combined with a CD-ROM reader, such dual-purpose optical systems are available today only in a 3.5-inch format. With most of the popular CD-ROM software titles available only in a 5.25-inch format, for the time being we'd have to use separate units in order to load popular CD-ROM software and write to an optical disk. Not only will the inclusion of a CD-ROM allow easy and quick loading of software, but with the addition of a 16-bit stereo record/play sound board and high-quality speakers, the dream machine turns into the dream multimedia machine. A word of warning: Treat this part of the PC as if you're shopping for a stereo; choose components that have the most natural sound. Rounding out the peripherals package will be the fastest modem available, operating at 14.4 kilobits per second, with suitable error-control and compression capabilities and send/receive fax operation.

With a Pentium CPU—the highest member of the PC food chain—an advanced bus structure will be used to reduce potential bottlenecks in data flow. While IBM's Micro Channel architecture is a possibility, the practical decision leans toward the EISA bus. In order to handle high-powered graphical environments and applications, the dream machine's display technology will be achieved through a local bus. We recommend steering clear of a proprietary system and, for now, sticking with the VESA VL-Bus specification, which can produce performance in the range of 15 to 40 megapixels per second. When it becomes available later this year, we might consider Intel's PCI bus, the operation of which meshes quite well with that of the Pentium. With a 24-bit true-color video adapter, a graphics accelerator, and 2MB of video memory, the system can display 1,280-by-1,024 resolution and 16.7 million simultaneous colors. After spending so much on the system, don't skimp on the monitor: We suggest buying at least a 20-inch flat-screen monitor with a 0.25-mm dot pitch.

So that all these add-on boards don't cramp your style, the dream machine will be housed in a tower case with at least seven EISA expansion slots. The addition of an uninterruptible power supply would be a good idea for a system of this level; we consider it a highly recommended option. While this PC is designed for the computing upper crust with no price ceiling, the bill will likely top $10,000. But this machine will not only give you the pinnacle of personal computing power, it will quite likely make you the object of PC envy.

2. The Windows Workstation

Price: Around $4,500.

THE WINDOWS WORKSTATION: GRAPHICS-INTENSIVE POWER PC

The practical meaning of the trickle-down theory of computing is that yesterday's high-flier quickly becomes today's midrange PC, at middle-of-the-pack prices. For the Windows workstation, this means choosing between the top-shelf 486 CPUs: a 50-MHz DX or 66-MHz DX2. Either processor will give the devoted Windows user the power and speed needed to juggle among several applications. This chip family includes 8K of internal cache to keep frequently used data at the ready, but you should plan on adding 256K of external cache for the 486DX/50 processor or 512K if the 486DX2/66 chip is used. If you are particularly future-minded, insist on the inclusion of a Pentium OverDrive socket that will accept Intel's P24T processor when it becomes available next year. For even the most die-hard Windows warrior, 8MB to 16MB of RAM should suffice, along with 2MB of hardware cache and a hard disk of at least 300MB.

For standard applications, the ISA bus will do fine, particularly if video is handled by a local bus. The Windows workstation should perform well with an accelerated adapter capable of at least 1,024-by-768 resolution along with a 17-inch monitor. To add sound to the sight, count on having a CD-ROM, 16-bit sound board, and properly shielded speakers. And, so that you're not swapping floppy disks in order to back up data, an internal digital tape unit is a necessity. As a workstation, this system will be tied into a network, and this connection should not be the weak link. Choose the network card carefully, aiming for one that maximizes throughput. The system wouldn't be

If *(wait)* this *(wait)* is *(wait)* how

(wait) your *(wait)* computer *(wait)*

does *(wait)* Windows, *(wait)*

have *(wait)* we *(wait)* got *(wait)* a

(wait) PC *(wait)* for *(wait)* you.

Don't wait. Put one of our Image™ Series 486 PCs on your desk immediately. You'll get Windows performance that really screams.

And we're not the only ones who feel that way. In a recent review of the Image Series, *PC World* wrote, "Say goodbye to waiting in Windows."

NEC pioneered local bus video technology to speed up graphics-based applications like Windows. Today, as other makers develop first-generation local bus video, we offer advanced, second-generation technology

Making it fast. Our ingenious Image Video™ technology combines second-generation local bus video with a powerful graphics accelerator, so even the most complex, most demanding graphics applications run full blast. And with our True Color support for over 16.8 million colors and photo-realistic images, those applications will have the impact of a speeding freight train. The bottom line: Your productivity takes a fast turn skyward. Our new Image PCs are built for easy, 238-pin ZIF-socket upgrades to the next generation of Pentium-based Intel OverDrive™ processors. We've also given them an on-board SCSI II interface, for quick connections to a wide range of peripherals.

But wait: it gets even better. In addition, NEC's OptiBus™ technology can make those peripherals perform up to 30% faster than ordinary systems. While our ImageSync™ feature delivers flawless, flicker-free images with no adjusting when used with one of our award-winning MultiSync® FG™ monitors.

The NEC Image Series. Just part of a whole family of great personal computers, from our affordable PowerMate® PCs, to our expandable Express™ servers. So (why wait?), call 1-800-NEC-INFO or NEC FastFacts™ at 1-800-366-0476, request document 46243.

intel inside

PC WORLD BEST BUY

NEC Image 466
May 1993

IMAGE VIDEO

CIRCLE 239 ON READER SERVICE CARD

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NEC

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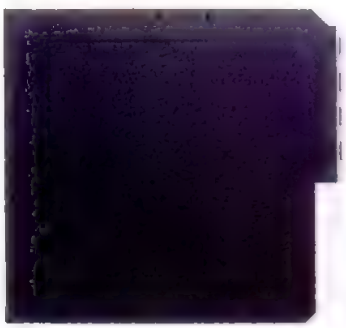
What will people make of Anything they want.

Versa's screen detaches easily, so you can quickly upgrade it, reverse the display or convert to pen.

For the ultimate in expansion and connectivity, Versa offers the latest PCMCIA Type III standard: plug in up to two cards—modems, LAN, storage or, in the future, wireless networking. What's more, our QuickSwap™ feature lets you change cards without powering down.

Choose Versa with 256 brilliant colors and the latest active-matrix screen technology, or with 64 crisp shades of gray. Either way, Versa is the first notebook to use local bus video architecture, for dramatically faster graphics performance

The LCD status panel gives a quick overview of what's going on inside your Versa—power management status, battery life and more



Versa comes standard with a Nickel Metal Hydride (NiMH) battery, for longer life and quick recharging.

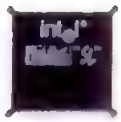
intel inside

*3-year limited warranty is standard. UltraCare enhanced warranty program is included in first year upon completion of UltraCare Versa registration card. For more details, call 1-800-NEC INFO. **Monochrome. 6.0 lbs. color 11lbs models/upgrades available 3rd quarter 1993. RAM expandable to 12MB today, 20MB over 3rd qtr '93. 33MHz over 3rd qtr '93. †This feature has not yet been approved by the Federal Communications Commission, and models with this feature will not be sold or leased until approval from the FCC has been obtained. UltraLite is a registered trademark of NEC Corporation. UltraLite Versa, FastFacts, QuickSwap and DoubleTime are trademarks and UltraCare a service mark of NEC Technologies, Inc. Docking Station is a trademark of NEC Home Electronics, Inc. The Intel Inside logo is a registered trademark of Intel Corp. All other trademarks or registered trademarks are the property of their respective holders. © 1993 NEC Technologies, Inc. NEC GSA#GS00K91AGS5241

our new UltraLite® Versa™?

Versa's RAM can be easily upgraded from 4MB to as much as 20MB† simply by sliding in a memory card.

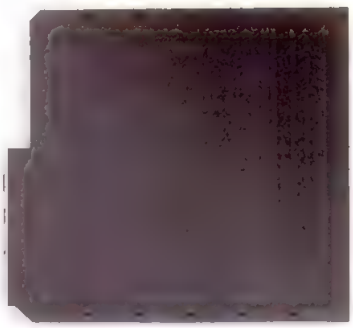
As with our award-winning monitors, printers, desktop PCs and CD-ROM readers, the new UltraLite Versa is a prime example of what NEC does best: integrating many new technologies into one seamless, highly functional package.



Versa offers powerful, energy-efficient 3.3V i486SL™ processing. Start with your choice of 20, 25 or 33MHz†‡ processor; upgrade as your computing needs increase.

Versa offers innovative active-matrix color pen computing,‡ as well as a monochrome pen model. Versa also converts to a tablet in seconds, for capturing signatures, taking notes or annotating presentations.

To increase Versa's storage capacity, just choose from 80MB, 120MB or 180MB removable hard drives. And Versa comes preloaded with Windows™ 3.1 and DOS® 6.0.



With our new DoubleTime™ technology, Versa's battery life can be doubled, instantly, by exchanging the floppy drive for a second battery. Result: an astounding 8-12 hours for monochrome, 5-10 hours for color, depending on usage.

The new UltraLite Versa is perhaps the one notebook computer you should want right now.

That's because Versa's exceptional upgradability and flexibility give you the power to choose the system you need today, and then enhance its features as your needs change.

Making it a notebook you'll *still* want years from now.

With Versa, you're protected from wasting money on a notebook you might soon outgrow. Protected, too, by a 3-year limited warranty and UltraCare℠ enhanced service plan.*

The 6-lb.** Versa is a light, powerful i486SL™ notebook that's perfect for heavy computing, faxing and communicating while on the road.

Giving you a real alternative to the mouse, Versa's optional pen models and pen upgrades† make it easy to take notes or enter data in the field.

Slipped into its optional Docking Station™ unit, Versa offers all the capabilities of a desktop computer. So what do you make of a notebook PC that does all that? Anything you want.

For details on the amazing UltraLite Versa, call 1-800-NEC-INFO or NEC FastFacts™ at 1-800-366-0476, request document 8583772.

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CIRCLE 394 ON READER SERVICE CARD

The Light Bulb 1879

Aspirin 1899

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MultiSpin™ from NEC.

Thanks to pioneers like Thomas Edison, you don't remember what it was like to read by candlelight. And thanks to NEC's MultiSpin™ CD-ROM readers, you won't be able to remember a time when you couldn't transfer data at a rate of 300 KB/second.

We revolutionized CD-ROM.

NEC was the first company to successfully bring dual-speed technology to market, and now has a complete family of readers designed to fit your needs. From our external MultiSpin 74 and internal MultiSpin 84, to our lightweight, portable MultiSpin 38.

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der how you ever lived without them.

Built for the future.

All of our readers support Kodak's Multisession Photo CD™ technology, so you can view photographs on CD and work with those images on your computer. All are SCSI 2 compatible, which increases compatibility across multiple platforms. And both the MultiSpin 74 and 84 have a 256 KB continuous flow cache that allows them to transfer encyclopedias of data at high speeds and play back video without any pauses in motion. And the MultiSpin 38 gives you the power of portability. Best of all, they all come with a two-year warranty.

In 1985 NEC redefined monitors with the invention of MultiSync® technology. Now there is MultiSpin. The technology that has redefined CD-ROM readers.

Multimedia's never been so easy.

What's more, all of them are QuickTime™ compatible and meet the Multimedia PC (MPC) standards for Multimedia computing. Once you check out the high-performance CD-ROM readers from the pioneers of MultiSpin technology, you'll find everything else about as primitive as traveling by horse and buggy. To find out more, call 1-800-NEC-INFO (in Canada 1-800-343-4418). Or, via fax, call NEC FastFacts™ at 1-800-366-0476, request #23766.

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NEC

CIRCLE 153 ON READER SERVICE CARD

complete without a fast and capable modem. Count on getting at least a 14.4-Kbps modem with fax capability.

This system might be seen as the result of the collision between the dream of a perfect PC and the reality of a tight budget. Plan on spending about $3,750 for this system, housed in either a desktop or a small tower.

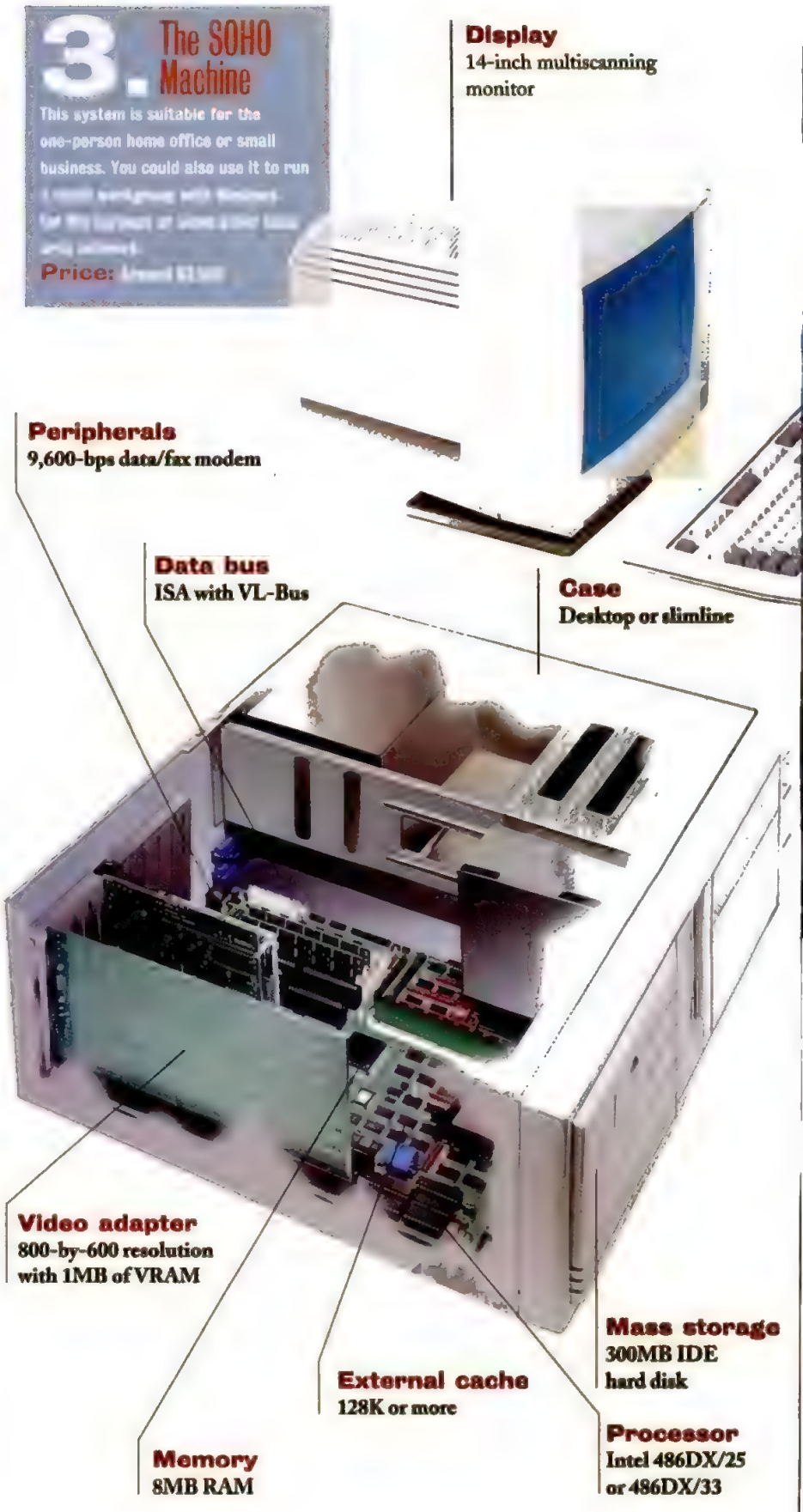
SOHO: COMPUTING GETS DOWN TO BUSINESS

Because of the array of tasks it needs to perform and the limited budget under which most businesses operate, the prototype small office, home office (SOHO) PC system must do the most for the least. Whether it is set up as a standalone PC or as part of a network, the most cost-effective SOHO system will be driven by either a 486DX/25 or the slightly more expensive 486DX/33 processor. Make sure the system contains an OverDrive socket so that it can be upgraded with a clock-doubled DX2/50 or DX2/66 to give the PC an inexpensive midlife performance kick. Just as in the flashier systems described above, external cache is needed, but 128K should be enough. A minimum of 8MB of system memory and a 300MB IDE hard disk will prove satisfactory. If data-storage needs rise, consider a data-compression program, such as the one included in DOS 6.0.

Because most small-business users rely on both DOS and Windows programs, the ISA bus plus a local-bus video system should be more than capable enough to handle 800-by-600 resolution with 1MB VRAM. Because of a tight budget, we chose a 14-inch monitor. With the inclusion of a 9,600-bps fax modem, this system should cost no more than $2,500, a price that should help with any small business's bottom line.

THE SERVER: NETWORK SUPPORT FOR A MIDSIZE LAN

Acting as the nervous system of a company, the local area network's server requires some extra planning and consideration. Based on a network of about one hundred clients using NetWare 3.11, plan on the server costing $15,000. The range of CPUs is a bit wider than other prototype PCs, and includes the 486DX/50, DX2/66, Pentium/60, and Pentium/66.

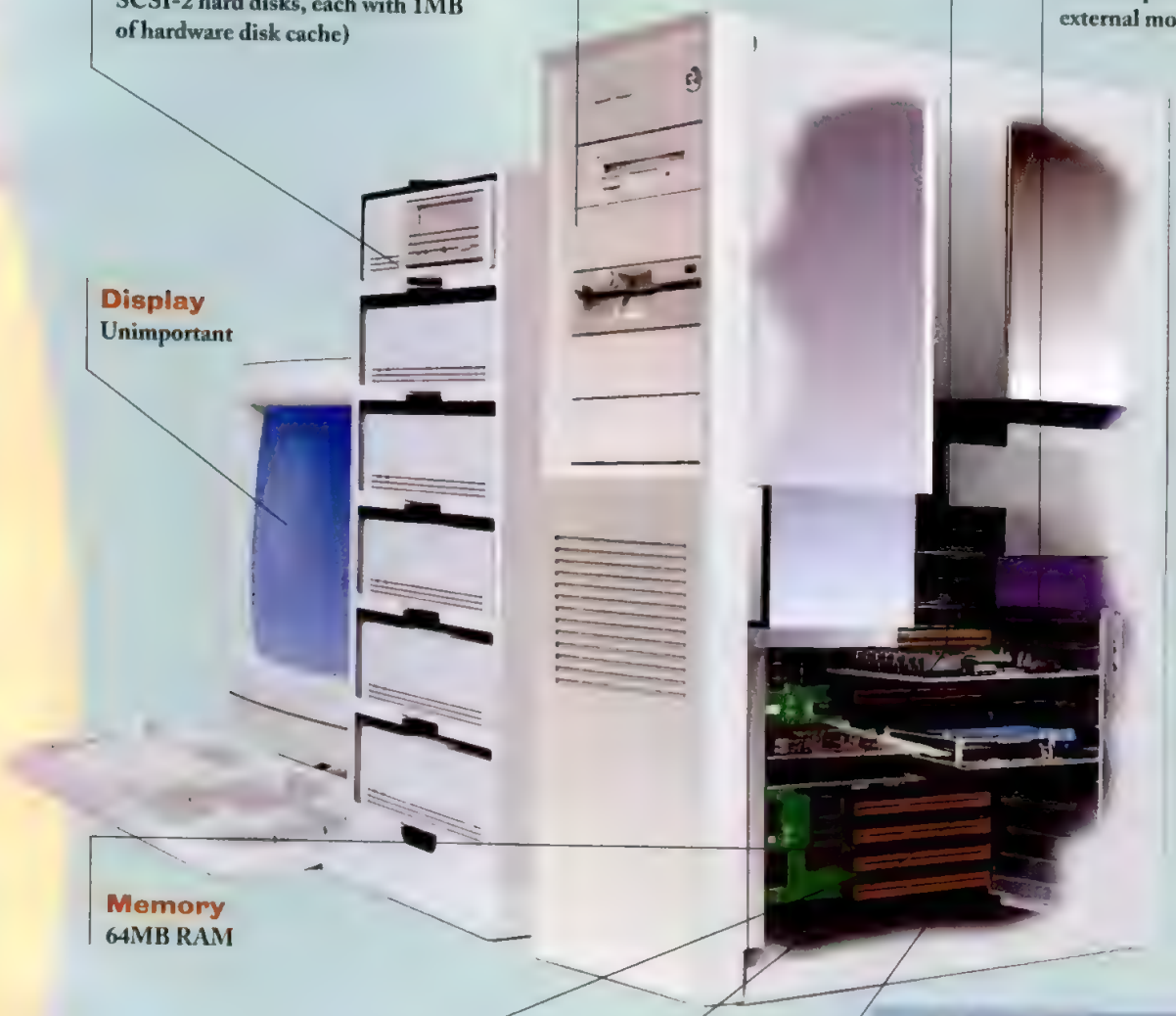


Case
A large tower with front and rear mechanical case security, side-panel doors, 16-character LCD, and rolling casters

Processor
Intel 486DX/50, 486DX2/66, or Pentium, with the ability to upgrade to multiple processors (2 to 4)

Mass storage
2GB mass storage (configured as four or five RAID 5–compliant SCSI-2 hard disks, each with 1MB of hardware disk cache)

Peripherals
19.6-Kbps internal or external modem



Display
Unimportant

Memory
64MB RAM

External cache
512K

Video adapter
Unimportant

Data bus

4. The Server

Price:

Based on our tests of high-end file servers in this year's May 11 issue of *PC Magazine* ("To Protect and Serve"), either of the fast 486 chips should do just fine for a network of up to 120 simultaneous users. Plan on giving the network some headroom by making sure the system can handle multiprocessing. This may end up costing an extra thousand dollars at the time of purchase, but it will be money well invested when you need to add 50 workstations quickly and inexpensively to your network.

For this class of system, external cache is extremely important: Specify 512K. System memory should be 64MB but could rise further depending on the number of clients connected at the start; most file servers can take up to 128MB of RAM or more, and this is an inexpensive way to boost performance. Producing the system's 2GB of network mass storage entails some opportunities and challenges. The choices are two large drives that are mirrored for data safety, or five 400MB hard disks set up in a redundant array—or RAID. You might find that the better performance of a RAID system is well worth paying extra.

Not only would it be silly to house the server in anything but a tower case, its bus must be either EISA, MCA, or a proprietary system like Acer's FrameBus. Unlike the case with the other systems presented here, display technology is unimportant because its role will be to monitor network functions. Other items that require attention include the system's network interface cards, which must be chosen to optimize data throughput, a UPS, remote failure notification, and 4-hour on-site service.

It is possible—indeed, likely—that your ideal personal computer may not be described here. Rather than an indication of deviant behavior or unreasonable expectations on your part, it's a matter of your computing needs not exactly matching ours. The PC that will satisfy you may actually be an amalgam of several of those that are described in this story, because there are as many perfect PCs as there are users and patterns of PC activity. □

What's in a Value Line

by Oliver Rist

On the surface, the difference between big-name value PCs and their midrange siblings seems to be size: The values are in slimline cases while, the midrange machines occupy full-size desktops. But be careful, there is more at stake here than just room for future expansion.

The case size does, however, give you valuable insight into how manufacturers are classifying value customers. You can't expand a slimline system all that much, and doing so becomes an unnecessarily cramped procedure. Taking that at face value, it would seem that manufacturers are targeting value products mainly at those users who won't want to upgrade. For instance, if you're a power user on a budget, a Compaq ProLinea probably isn't for you. Another approach is to start with a stripped down Compaq Deskpro I or Deskpro M and work up from there.

CHECK OUT THE PACKAGE

Things to watch out for in the value-line arena depend on what kind of customer you are. If you're one of the target market—those who don't think they'll need to upgrade—check out the overall package. Many of the non-upgrading customers are corporate types buying in quantity; a change of hardware en masse for the word processing department, for instance. If you're one of these, make sure you're buying from a manufacturer who can support you when the machines break down.

Look at the hardware. You'll want the usual, like a large hard disk—but not so large that it'll drive the price up substantially. You'll need at least 4MB of RAM for GUI word processors, a color monitor, and a cheap but speedy video adapter.

Once you've covered the basics, look closer. What kind of bundling options are there? Do you get a mouse? Is the included software preinstalled on your system, and if so, do you get the original disks? (You'll want these if you ever need cheap upgrades to your applications; without them you're stuck repurchasing the applications at full price.) Is the warranty for the value product the same as for the higher-priced PC? Are you interested in user ergonomics—tilt/swivel monitors, low radiation emissions, low power consumption, and high video refresh rates? You should bombard your vendor with these questions *before* you buy a value product.

Those of you falling into the "upgrade" crowd will have to tackle even more complex issues. First, stay away from slimline cases—not just because they offer fewer drive bays and frequently have smaller power supplies, but because full-size desktops give you easier access to your motherboard.

UPGRADE CONCERNS

Along those lines, find out which motherboard you're getting and confirm that you *can* upgrade the microprocessor and other elements. SIMM chips for RAM and external cache memory allow you to perform upgrades yourself. Straight DRAM soldered onto the board means a trip to the technician. Make sure that your BIOS can handle a change of oscillator and processing power, and that your CPU and clock crystal aren't soldered to the board, either.

If you decide to forgo an established brand in favor of a lesser-known but juicier system, try to ensure that it is composed of name-brand components. If the vendor goes out of business, at least you could get your warranty filled on these parts—like Micronics or Orchid motherboards; Conner, Maxtor, or Seagate hard disks; Adaptec or Ultrastor disk controllers; Sony or TEAC floppy disk drives; MAG, Nanao, NEC, or Sony monitors; and ATI, Genoa, or Orchid video cards, to name but a few. □

A Solid Case for Real Power.

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John Dvorak, *PC Magazine*, March 30, 1993
"The only company to go to for a power supply"
Jerry Pournelle, *Byte*, April 1993

STANDARD UNITS

These UL/CSA approved, fully tested power supplies are the best basic units available.

STANDARD 205 SLIM $89
STANDARD 220 AT/TOWER $89

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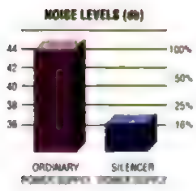

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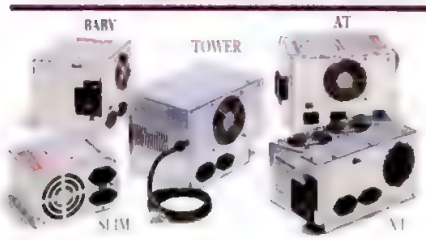

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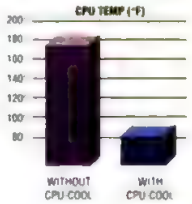

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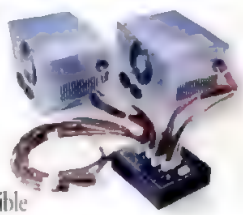

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The PERFECT SYSTEM

WHAT MAJOR DECISIONS MUST YOU MAKE WHEN SELECTING A SYSTEM TO SUIT YOUR NEEDS? WE LOOK AT WHAT GOES INTO SHOPPING FOR YOUR PERFECT PC.

BY WINN L. ROSCH

Beauty may lie in the beholder's eye, but perfection goes deeper. It's all in your head. A perfect 10 in anything—from a relationship to your next PC—starts with meeting or exceeding expectations, fulfilling desires, and matching reality to your preconceived notions of need. But just as you can change your mind, the notion of faultlessness changes, too.

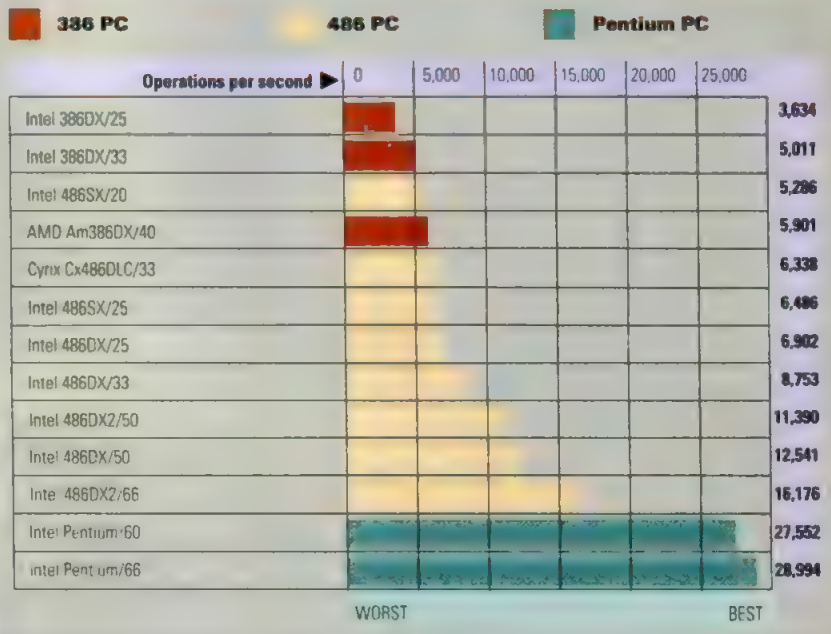
Nowhere is the mutability of perfection as obvious as among personal computers. Yesterday's flawless choice is no more than today's historical footnote; what once was blindingly fast now seems to crawl. Since July 1992, when *PC Magazine* last examined what constitutes the perfect PC, the entire industry dramatically reshuffled itself as technology raced into the fast lane. PC prices plummeted, and once-exotic technologies like the local bus, graphics acceleration, and SCSI devices are now commonplace. The result: The PC that's perfect for you today is a far cry from the dream machine you pined for only a year ago, particularly if your budget was (and is still) tight.

Despite the changes in technology and the industry, however, one aspect of the search for the perfect PC remains the same. The one machine that's exactly

CPU Throughput

This chart shows the throughput of today's most popular CPUs. Use it to compare the potential performance of value-line systems against that of midrange machines.

PCs: Average Processor Scores by Chip Type



HIGHLIGHTS

The Perfect PC

THE SEARCH FOR the perfect PC is a very personal affair and should reflect how you plan to use the system. Start by examining your needs, requirements, and budget. Aim high by shooting for the fastest, most-up-to-date personal computer you can afford, and then cut corners by eliminating some of the luxuries.

YOUR SIX PRIMARY CONCERNS when putting together the perfect PC are selecting the correct CPU, system memory, expansion bus, case size and dynamics, mass data storage, and display technology.

FOUR PROTOTYPE personal computers—a dream machine, a Microsoft Windows workstation, a small business system, and a LAN sever—show the diversity of performance available from the general PC platform. Small configuration changes lead to vastly differing personalities.

THE 286 IS DEAD; the 386 is dying. Long live the 486. The minimum-level CPU you should consider today for general PC applications is a 486SX.

INTEL'S PENTIUM CHIP is currently the fastest and most powerful. Available in 60-MHz and 66-MHz versions, it can churn through software about 75 percent faster than a 486DX2/66 CPU can. Expect to pay at least twice the price of a same-speed 486 chip.

THE CHIP WAR heats up as Intel introduces a variety of new processors, and AMD and Cyrix follow suit. Expect a 100-MHz processor from Intel, as well as more powerful 486 clones from AMD and Cyrix, in a variety of speeds.

A MEMORY CACHE coordinates today's fast microprocessors with slower memory subsystems. The 8K internal cache for data and instructions on Intel's 486 line and Pentium's 16K are not enough for today's applications, however. Plan on adding an amount of external cache that is sufficient for your software tasks. For a server, 512K will be adequate, but as little as 128K is more than enough for a general business system.

THE BUS ROUTE YOU CHOOSE will affect the system's capabilities. ISA will be fine for general computing, but you will need an extended bus, like EISA or MCA, for data-intensive jobs such as those a file server deals with. You should plan on adding a local-bus video connection to speed up your display.

PORTABLE PCs present a double-edged sword: Powerful and capable, they can substitute for a desktop in certain situations but disappoint the general business user in terms of security, expansion, and display technology.

right for you is a personal choice that's as dependent on your exact needs as on what the industry has to offer. The strategy for finding it is also unchanged: Determine the highest price you can afford, determine the must-have hardware features, and compare the two. Finally, choose the corners you can cut without losing any main elements of your PC.

When selecting a new system, you have six primary concerns: the microprocessor, memory, expansion bus, packaging, mass storage, and display technology. We discuss the first four here, in this story. Because the last two are so important and include so many issues of their own, we've devoted separate articles to them.

Constructing a PC within a rigid price ceiling is a game of trade-offs. Should you get that ultrafast CPU you've been hankering for and compensate by sticking with the motherboard's built-in video circuitry? Settle for a slower CPU and spend the rest on a faster modem? Forgo a sound board and get a larger monitor? The choices and possible combinations seem endless.

You will first need to choose the minimum power level you'll need—that is, the most appropriate microprocessor. In the last year, the range of choices has broadened considerably as Intel and other companies have rolled out a slew of new designs and speed ratings. Because the market is so tumultuous, the only thing you can be sure of is that the 286 CPU family is and will remain dead.

THE PC DIVIDING LINE

The 386SX remains the dividing line between microprocessors. Lesser chips simply cannot run memory management utilities or the latest 32-bit software. At the 386 level and beyond, you'll find no significant difference in terms of software compatibility; the difference lies in speed. Just as the 286's days are in the past, the 386 is passé today, with the 486SX defining the entry level in terms of both price and performance.

While the 386DX and 486SX are priced within a few dollars of one another, the latter provides about twice the power of a 386DX running at the same clock speed. For instance, a 40-MHz 386DX and 20-MHz 486SX are about on a par with each other. Many 386 machines remain on the market, but today's 486SX prices leave but one market for desktop 386s: the PC industry's bottom feeders, which suck up buyers in search of bargains.

Among laptop computers, 386 technology lingers on because of low performance expectations and the need to conserve battery power. The 386SL—a 386SX off-shoot that includes power-management and speed-reduction facilities to prolong battery life—remains a popular alternative for portables, particularly since several systems have street prices nearing $1,000. The evolution has

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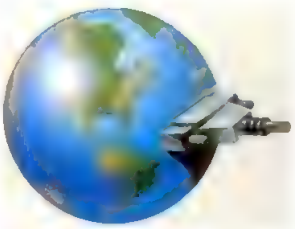

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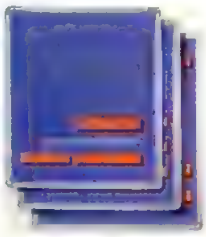

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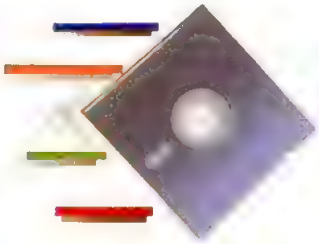

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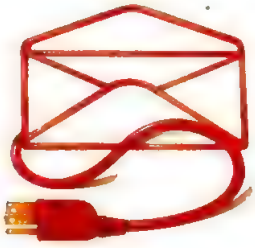

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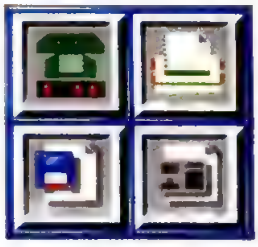

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continued, with the 386SL replaced by the 486SL/25, which runs at 3.3 volts and also has power management.

The downside is that the SL line will end with the 33-MHz 486SL. Intel is migrating the functionality of the SL design to the company's desktop-chip families, foretelling the advent of power-managed desktop PCs. This could be the first step toward fulfilling the Environmental Protection Agency's Energy Star effort at power-managed PCs (for more information, see "The Green Machine," May 25, 1993).

For the time being, the 486DX2/66 microprocessor will remain the value choice for power users.

For desktop machines, Intel's 486 isn't a single species but a menagerie, with each chip aimed at a specific pattern of use and audience. A dividing line separates the SX from the DX and DX2.

DX and DX2 chips each include an integral floating-point unit—that is, a built-in math coprocessor. The SX does not. Apart from that, there is much similarity. All 486 chips are built around 32-bit internal and external architectures and include an internal 8K RAM cache.

Megahertz for megahertz, the SX and DX variants of the 486 line will deliver identical performance on general business and home applications, which don't use many floating-point operations. Today's 486SX microprocessors are available in 16-, 20-, 25-, and 33-MHz versions; 486DX chips come in 25-, 33-, 40-, and 50-MHz flavors, and 486DX2 chips in 50- and 66-MHz varieties. The extra $100 you will pay for a 486DX over the same-speed 486SX is worth it if your applications make heavy use of floating-point circuitry.

As we went to press, Advanced Micro Devices joined the 486 crowd with 33-MHz and 40-MHz DX variations. Initial reports show no compatibility problems, and performance that's right in line with Intel's same-speed product. Later this summer AMD will follow this CPU with a clock-doubled 486DX2/50. A wildcard remains: an uncertain legal position and the inevitability of future courtroom wranglings between Intel and AMD.

START AT THE TOP

The current speed demon of the PC world is Intel's Pentium, which comes in 60-MHz and 66-MHz versions. With a 64-bit internal architecture and a superscalar design, the Pentium zips through general PC software about 75 percent faster than a 486DX2/66 (see "Pentium Power," April 27, 1993, for more information). The real performance benefits of the Pentium are based on its enhanced floating-point unit, which is at least five times more capable than its 486 predecessors. The chip will also be ahead of the software curve until the appearance of the next generation of 64-bit application software, which will use operating systems like the long-promised Microsoft Windows NT.

Because the Pentium is new, fast, and in short supply, it carries a price premium inconsistent with the additional performance it provides (for more information, see "Pentium PCs: The New Standard,"

A Case-by-Case Study

Desktop

A desktop PC offers excellent expandability for home power users willing to sacrifice some desktop space. A roomy interior makes it easy to access the expansion slots and drive bays.

Typical dimensions (HWD): 6 by 21 by 16.5 inches.
Motherboard alignment: Horizontal
Number of expansion slots: Five or six
Number of drive bays: Three to five.
Typical drive bay setup: One or more 5.25-inch, two 3.5-inch

Small-footprint

A smaller footprint saves space but limits expansion capabilities. This type of PC is acceptable for home users who need to expand their systems only occasionally.

Typical dimensions (HWD): 6 by 16 by 16 inches.
Motherboard alignment: Horizontal
Number of expansion slots: Five.
Number of drive bays: Three.
Typical drive bay setup: One 5.25-inch, two 3.5-inch

Slimline

Slimlines generally have a more attractive case that appeals to home users who are not concerned with expanding their systems. They make excellent office workstations. The cramped interior makes access to drive bays and expansion slots difficult.

Typical dimensions (HWD): 4 by 16 by 16 inches.
Motherboard alignment: Horizontal.
Number of expansion slots: Three.
Number of drive bays: Two or three.
Typical drive bay setup: One 5.25-inch, one 3.5-inch.

June 29, 1993). Expect the CPU to cost at least twice the price of the closest-speed 486 CPU. For the time being, the 486DX2/66 will remain the value choice for power users.

The DX2 line from Intel is distinguished from the DX line by an internal clock-doubling circuit that lets the CPU's core work twice as fast as the rest of the chip. That is, the DX2 connects with a system board that operates at half the chip's internal computing speed, which allows for less expensive components. For example, the 486DX2/66 uses a 33-MHz motherboard.

Depending on the applications you use, a DX2 will deliver from 70 to 90 percent of the performance of a DX with the same internal speed rating. That makes a 486DX/50 MHz faster than a corresponding 486DX2/50. In the hierarchy of computing, comparing a 50-MHz DX to a 66-MHz DX2 is problematic. The DX2 is better at processor-intensive tasks (calculation- and graphic-intensive programs); the plain DX is faster at memory-intensive applications.

Because 50-MHz motherboards are difficult to design and manufacture, many PC makers have focused their attention on the 486DX2/66 and orphaned the 486DX/50. Beyond the DX2, expect to see 486 microprocessors capable of clock-tripling; we anticipate CPUs with 100-MHz speed ratings entering the market this year. Both Intel and IBM have plans for such chips.

Last year Cyrix released two 486-type chips, which are also sold under the Texas Instruments logo. Cyrix did the design, TI does the manufacturing. The 486SLC/e incorporates the full 486 command set, but its design relies on 32-bit internal registers and 16-bit input/output connections; this is as much a 386SX design as a 486 one. The 486DLC resembles the 386DX, using the same pin layout with full 32-bit connections. Neither chip, however, is a plug-in replacement for its 386 equivalent, since BIOS modifications are required for full compatibility.

Except for bus-control circuitry, the two Cyrix chips are internally identical. Instead of Intel's 8K internal memory cache, each has 1K. Neither has an integrated floating-point unit. Cyrix does compensate in two ways: An on-chip hardware multiplier lets the Cyrix chips chew through simple integer math about four times as fast as Intel chips with the same speed rating, which rely on microcode for integer math functions. In addition, Cyrix offers a combination CPU and external Cyrix 80387 math coprocessor for as little as $30 extra in quantities of 1,000.

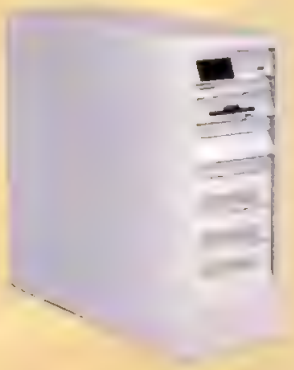
Because the 486 CPU is socket-compatible with 386 microprocessors, PC makers have converted 386 motherboards to handle 486s—in name if not performance—at minimal costs. Such PCs will keep defining the low end of the desktop computing spectrum for price and performance.

IBM also offers its own 486 CPUs, which are a licensed design offshoot of Intel's chips. Going by the same name, the 486SLC family from IBM is an interesting mix of old and new: a 386SX-like architecture (32-bit internally, 16-bit externally); but a large 16K internal cache; clock-doubling technology; and a more efficient design that makes it faster, megahertz for megahertz, than Intel's own designs. IBM cannot sell the SLC chips to other vendors, but through its Austin, Texas, assembly plant IBM sells complete motherboards to other vendors.

When you put it all together, a 486SX CPU or better is all you will need to churn

Mini-tower

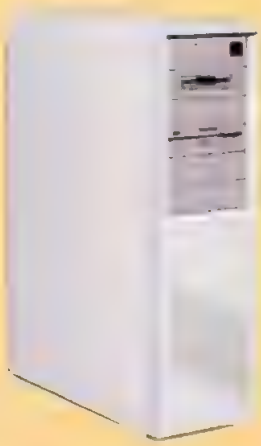
A mini-tower is an excellent alternative for home power users who have limited desk space and want quick, unobstructed access to expansion slots and drive bays. Mini-towers can also be mini-servers.



Typical dimensions (HWD): 17 by 6 by 17 inches.
Motherboard alignment: Vertical
Number of expansion slots: Six to eight
Number of drive bays: Four or five
Typical drive bay setup: Two or three 5.25-inch, two 3.5-inch

Tower

Built for expansion, tower units are generally used as servers. Because of their size, they are not practical for home use or as office workstations.



Typical dimensions (HWD): 24 by 6 by 17 inches
Motherboard alignment: Vertical
Number of expansion slots: Eight or more
Number of drive bays: Six or more
Typical drive bay setup: Three or four 5.25-inch, two or three 3.5-inch

through general word processing and communications applications. If your work pattern leans toward graphics and spreadsheets, the addition of a separate coprocessor or an upgrade to a DX makes sense. And if your work takes you into large databases or software development, it's likely that only a DX2/66 or Pentium will satisfy you.

MEMORY MATTERS

After the microprocessor, the next consideration in building your perfect PC is memory, which comes in three types: ROM, RAM, and cache.

- *ROM*, or read-only memory, is set at the factory and generally can't be changed during normal operation. ROM is primarily used to store the PC's Basic Input/Output System (BIOS), which endows the machine with its personality and compatibility with peripherals. The trend today is to store the BIOS in flash memory so you can easily update it.
- *RAM*, or random access memory, is used by your system's CPU to run programs. The minimum you'll find in a modern PC is 1MB—clearly inadequate for today's megabyte-hungry programs. Microsoft Windows 3.1 requires 4MB; OS/2 2.0 needs 8MB. Double these numbers and the programs will perform the way they are designed to (see the sidebar "RAM: Is More Always Better?").

The current method of choice for packaging RAM is single in-line memory modules (SIMMs). SIMMs come in 1MB, 4MB, 8MB, and soon 16MB increments. The 1MB modules are the most common but are yielding in popularity to 4MB SIMMs. The 4MB module lets the owner of a system with eight RAM sockets pack a PC with 32MB, four times as much as the maximum provided by 1MB units. Note, however, that some PCs may have problems addressing more than 16MB of RAM. If you have plans to go higher, check this out before you buy.

Another potential memory problem is that the direct-aperture addressing of some display adapters (for example, IBM's XGA and the ATI Graphics Ultra) can conflict with RAM in ISA systems with close to 16MB of memory.

- A *memory cache* helps to match fast CPUs to slower memory. As mentioned earlier, the 486 has an 8K internal cache

PC Processors: The Current Lineup

Chip	Speed	Internal cache	Math coprocessor
Intel 386SX	16 MHz	None	External
Intel 386SX	20 MHz	None	External
Intel 386SX	25 MHz	None	External
Intel 386SX	33 MHz	None	External
Intel 386SL *	16 MHz	None	External
Intel 386SL *	20 MHz	None	External
Intel 386SL	25 MHz	None	External
Intel 386DX	16 MHz	None	External
Intel 386DX	20 MHz	None	External
Intel 386DX	25 MHz	None	External
Intel 386DX	33 MHz	None	External
Intel 486SX *	16 MHz	8K write-through	External
Intel 486SX *	20 MHz	8K write-through	External
Intel 486SX *	25 MHz	8K write-through	External
Intel 486SX	33 MHz	8K write-through	External
Intel 486SL	25 MHz	8K write-through	Internal
Intel 486DX	25 MHz	8K write-through	Internal
Intel 486DX	33 MHz	8K write-through	Internal
Intel 486DX	40 MHz	8K write-through	Internal
Intel 486DX	50 MHz	8K write-through	Internal
Intel 486DX2	25 or 50 MHz	8K write-through	Internal
Intel Pentium	33 or 66 MHz	8K write-through	Internal
Intel Pentium	60 MHz	16K write-back	Internal
Intel Pentium	66 MHz	16K write-back	Internal
AMD Am386SX *	25 MHz	None	External
AMD Am386SX	33 MHz	None	External
AMD Am386SX	40 MHz	None	External
AMD Am386DX *	25 MHz	None	External
AMD Am386DX	33 MHz	None	External
AMD Am386DX	40 MHz	None	External
AMD Am486DX *	33 MHz	8K write-through	Internal
AMD Am486DX	40 MHz	8K write-through	Internal
AMD Am486DX2-50	25 or 50 MHz	8K write-through	Internal
Cyrix Cx486SLC/e *	25 MHz	1K	External
Cyrix Cx486SLC/e *	33 MHz	1K	External
Cyrix Cx486DLC *	33 MHz	1K	External
Cyrix Cx486DLC *	40 MHz	1K	External
Cyrix Cx486S *	33 MHz	2K write-back	External
Cyrix Cx486S *	40 MHz	2K write-back	External
Cyrix Cx486S *	50 MHz	2K write-back	External
Cyrix Cx486S2 *	20 or 40 MHz	2K write-back	External
Cyrix Cx486S2 *	25 or 50 MHz	2K write-back	External
Cyrix M7 (code name) *	33 MHz	8K write-back	Internal
Cyrix M7 (code name) *	40 MHz	8K write-back	Internal
Cyrix M7 (code name) *	50 MHz	8K write-back	Internal
Cyrix M7 (doubled) *	20 or 40 MHz	8K write-back	Internal
Cyrix M7 (doubled) *	25 or 50 MHz	8K write-back	Internal
Cyrix M7 (doubled) *	33 or 66 MHz	8K write-back	Internal
IBM 386SLC	25 MHz	None	Info not available
IBM 486SLC *	25 MHz	16K	Info not available
IBM 486SLC2 *	25 or 50 MHz	16K	Info not available
IBM 486SLC2 *	33 or 66 MHz	16K	Info not available
IBM Blue Lightning *	25 or 75 MHz	16K	Info not available
IBM Blue Lightning *	33 or 100 MHz	16K	Info not available

* A low-voltage, 3.3-volt version of this chip is also available.

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Over the last fourteen years, Micron has gained worldwide recognition as a leading memory manufacturer. With facilities spanning over 1 million square feet and more than 4,500 dedicated employees, Micron has grown to become one of the largest companies in Idaho. Not what you would call "small potatoes". Quality Micron DRAMs, SRAMs and VRAMs are found in millions of computers and other electronic devices. Micron engineers continue the legacy by designing award winning high-performance systems using an internal supply of "MADE IN USA" memory components. These Micron systems are built with the same attention to detail and quality, and come loaded with enough memory to satisfy even the most demanding software.

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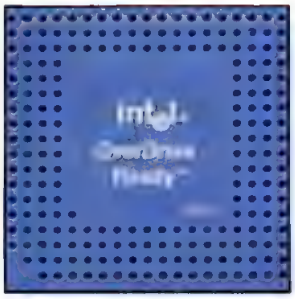
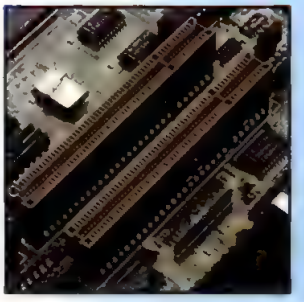


At the heart of every Micron 486VL system is a Zero Insertion Force (ZIF) socket designed for processor upgrades from the 33MHz 486SX to the 66MHz 486DX2 all the way to Intel's future Pentium based Overdrive processors. Just lift the lever and change the processor.

VESA Local Bus • Block Mode IDE



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Powered by the Weitek™ P9000 the Viper VLB is up to 300% faster than the ATI Ultra Pro VLB. 2MB of VRAM provides 256 colors at 1280 x 1024 @ 74Hz and 16.7 million colors at 800 x 600. Turbo Windows and Panacea AutoCAD drivers included.

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With 256K of ultra-fast Micron 15ns SRAM cache, your systems memory architecture will be fully exploited. A large fast cache is essential for OverDrive processors. Upgradeable Flash BIOS allows you to update your firmware from a floppy drive or modem.

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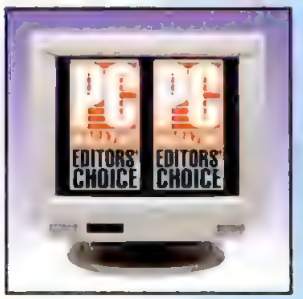

Award Winning MAG InnoVision monitors have received four PC Magazine Editors' Choice awards in consecutive years, providing unsurpassed clarity and features. Why settle for an average monitor when you can have the very best.

Rock Solid Quality Drives

Maxtor hard drives provide rock solid reliability with an average Mean-Time-Between-Failure (MTBF) of over 300,000 hours. Think of it as data insurance. Teac dual media floppy drives provide both 3.5" and 5.25" drives in a single drive bay freeing space for CD-ROM and tape drives.

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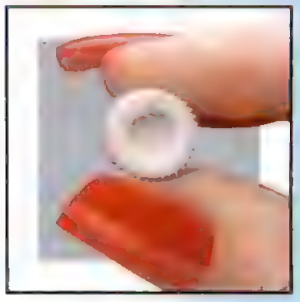

Upgrades are a snap with the "Tool Free" single thumbscrew design of the desktop chassis. A low profile heat sink comes standard on 66MHz systems for added cooling. 2.88MB floppy drive support assures you'll be ready when standards change.

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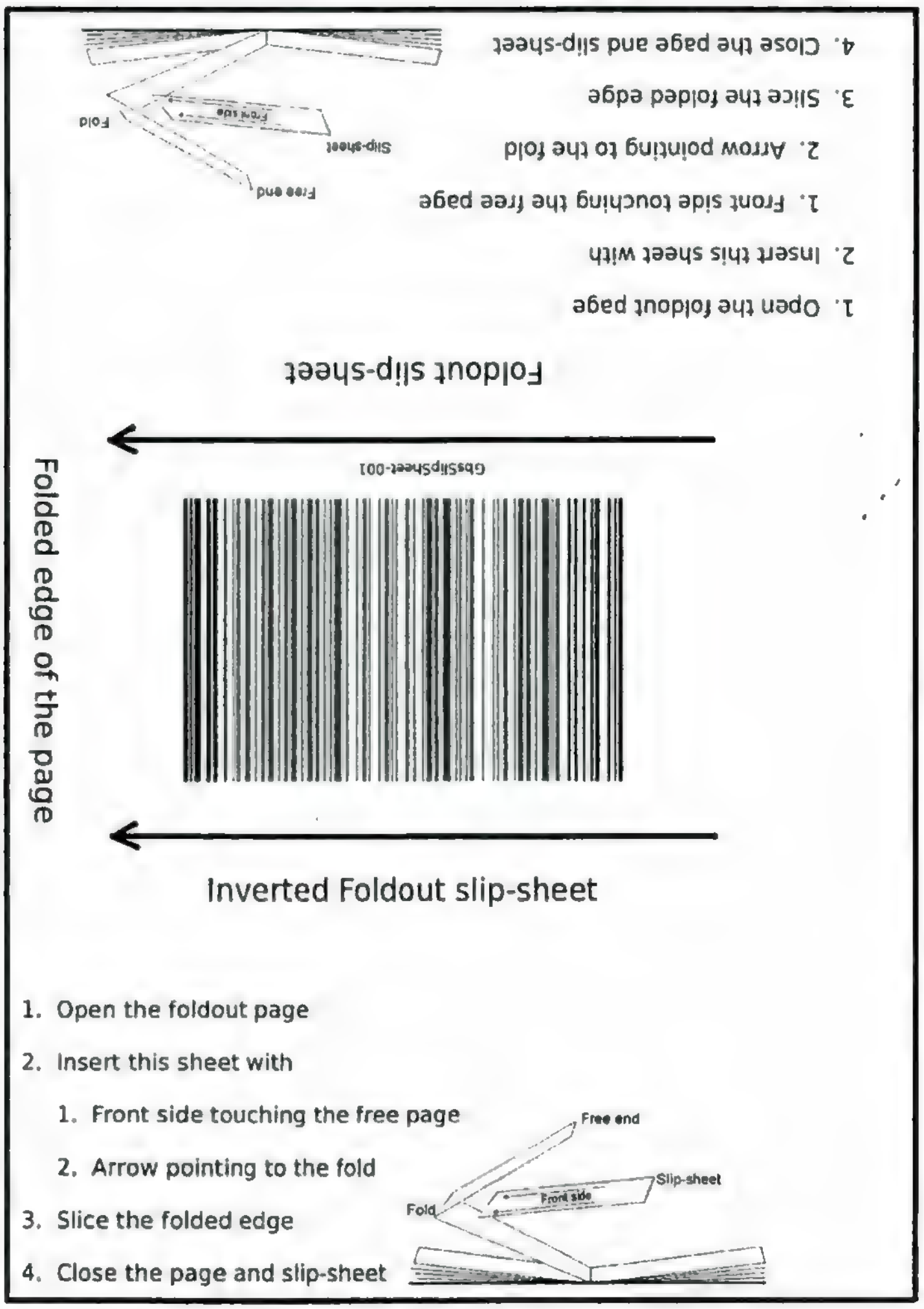
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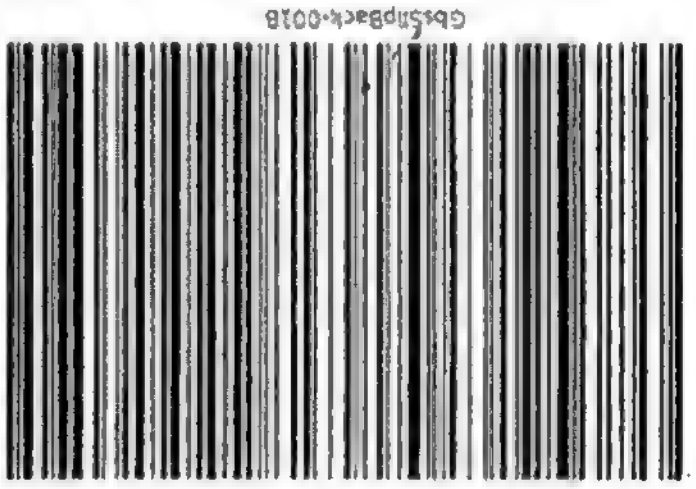
4. Close the page and slip-sheet
Free end
Slip-sheet
Front side
Fold
Inverted Foldout slip-sheet
1. Open the foldout page
2. Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet
Free end
Slip-sheet
Front side
Fold



Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

MICRON MEANS... QUALITY

PC MAGAZINE EDITORS' CHOICE

January 26, 1993
466 Magnum

New With Every System

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- Microsoft Windows™ 3.1
- Microsoft DOS 6
- Your choice of:
  - *WordPerfect for Windows*
  - *WordPerfect Presentations*
  - *Quattro Pro for Windows*
  - *Paradox for Windows*

Choice of Quality Software from WordPerfect or Borland

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WordPerfect Presentations is presentation graphics, designed for those who want to put together powerful, persuasive, and elegant presentations with a minimum of fuss.

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The new relational database from Borland that delivers ease of use, power and the tools you need to create graphical applications fast.

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- Intel™486 processor with 8K cache
- 238 pin ZIF socket for Pentium™ based OverDrive™processors
- 256K ultra-fast 15ns SRAM cache
- 8MB 70ns 36-bit RAM (up to 64MB)
- 7 Slots: 2 VESA (1 open), 7 ISA (6 open)
- Upgradeable Flash BIOS (Phoenix)
- Teac®dual drive 1.44MB 3.5", 1.2MB 5.25"
- Integrated 32-bit VESA local bus IDE interface with block mode transfer
- Maxtor®245MB 15ms IDE hard drive with block mode (300,000 hrs MTBF)
- Diamond SpeedStar Pro VLB accelerator 1MB RAM, Cirrus Logic 5426, 1280 x 1024
- 14" MAG LX1450 SVGA color monitor non-interlaced at 1024 x 768, .28dp
- 1 parallel, 2 serial ports (16550 compatible)
- Desktop chassis with "Tool Free" design
- 101-key enhanced keyboard
- Microsoft®Mouse 2.0 with Mouse Manager
- MS DOS 6, Enhanced Tools, Windows™3.1
- **Choice of one application software**

433•DX $1,999 Lease: $73/mo.
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486VL WinStation
16MB, 345MB, 15"

- Intel 486 processor with 8K cache
- 238 pin ZIF socket for Pentium based OverDrive processors
- 256K ultra-fast 15ns SRAM cache
- 16MB 70ns 36-bit RAM (up to 64MB)
- 7 Slots: 2 VESA (1 open), 7 ISA (6 open)
- Upgradeable Flash BIOS (Phoenix)
- Teac dual drive 1.44MB 3.5", 1.2MB 5.25"
- Integrated 32-bit VESA local bus IDE interface with block mode transfer
- Maxtor 345MB 14ms IDE hard drive with block mode (300,000 hrs MTBF)
- Diamond Viper VLB graphics accelerator 2MB VRAM, Weitek™ P9000, 1280 x 1024
- 15" MAG LX1564 SVGA color monitor non-interlaced at 1280 x 1024, .28dp
- 1 parallel, 2 serial ports (16550 compatible)
- Desktop chassis with "Tool Free" design
- 101-key enhanced keyboard
- Microsoft Mouse 2.0 with Mouse Manager
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- **Choice of one application software**

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486VL PowerStation
16MB, 345MB, 17"

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- 238 pin ZIF socket for Pentium based OverDrive processors
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- 16MB 70ns 36-bit RAM (up to 64MB)
- 7 Slots: 2 VESA, 7 ISA (5 open)
- Upgradeable Flash BIOS (Phoenix)
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EISA-VESA, SCSI-2

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- 238 pin ZIF socket for Pentium based OverDrive processors
- 256K ultra-fast 15ns SRAM cache
- **16MB 70ns 36-bit RAM (up to 64MB)**
- 8 Slots: 2 VESA, 8 EISA (6 open)
- Upgradeable Flash BIOS (Phoenix)
- Teac dual drive 1.44MB 3.5", 1.2MB 5.25"
- VL-bus 32-bit bus mastering Fast SCSI-2 controller (up to seven devices)
- **Maxtor 1.2GB 9ms SCSI-2 hard drive up to 44MBits/sec (300,000 hrs MTBF)**
- Diamond SpeedStar Pro VLB accelerator 1MB RAM, Cirrus Logic 5426, 1280 x 1024
- 14" MAG LX1450 SVGA color monitor non-interlaced at 1024 x 768, .28dp
- 1 parallel, 2 serial ports (16550 compatible)
- Tower chassis with 7 drive bays (5 open)
- 101-key enhanced keyboard
- Microsoft Mouse 2.0 with Mouse Manager
- MS DOS 6, Enhanced Tools, Windows 3.1
- **Choice of one application software**

433•DX $3,899 Lease: $135/mo.
466•DX2 $4,199 Lease: $146/mo.

486VL WinServer
EISA-VESA, SCSI-2

- Intel 486 processor with 8K cache
- 238 pin ZIF socket for Pentium based OverDrive processors
- 256K ultra-fast 15ns SRAM cache
- **16MB 70ns 36-bit RAM (up to 64MB)**
- 8 Slots: 2 VESA, 8 EISA (6 open)
- Upgradeable Flash BIOS (Phoenix)
- Teac dual drive 1.44MB 3.5", 1.2MB 5.25"
- VL-bus 32-bit bus mastering Fast SCSI-2 controller (up to seven devices)
- **Maxtor 540MB 9ms SCSI-2 hard drive up to 44MBits/sec (300,000 hrs MTBF)**
- Diamond Viper VLB graphics accelerator 2MB VRAM, Weitek P9000, 1280 x 1024
- 15" MAG LX1564 SVGA color monitor non-interlaced at 1280 x 1024, .28dp
- 1 parallel, 2 serial ports (16550 compatible)
- Tower chassis with 7 drive bays (5 open)
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- 1 parallel, 1 game, 2 serial ports
- Desktop chassis with "Tool Free" design
- 101-key enhanced keyboard
- Microsoft Mouse 2.0 with Mouse Manager
- MS DOS 6, Enhanced Tools, Windows 3.1
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for data and instructions, but it has to be buttressed with a secondary external cache using very fast SRAM chips. Generally, the larger the secondary memory cache, the better the match between memory and the CPU, and the faster the PC. (This relationship is not linear.)

According to Intel, the 8K primary cache of a 486DX is usually sufficient for single-user systems. But because of the mismatch between the internal and external speeds of the 486DX2, taking full advantage of clock-doubling chips requires a substantial secondary cache (as does a multitasking PC running on any level of CPU). Intel recommends at least a 256K external cache for optimal performance.

BUS ROUTES

Much of what a PC does depends on moving data to and from the microprocessor and memory—exchanging files across the network, loading data from disk, and blasting pictures to the monitor. The primary speed limiter on these transfers is the input/output bus. Most PCs sold today still rely on the ISA bus that was used in the IBM AT, introduced nearly a decade ago. Much has happened to PCs since then, including a fortyfold increase in CPU performance. When operating at 8 MHz and using 16-bit connections, a PC's peak throughput is limited to 8 megabits per second. Today there are several alternatives when choosing a bus.

IBM's Micro Channel architecture (MCA), introduced in 1987, is now little more than a marketing footnote. By boosting the top speed to 10 MHz and

RAM: Is More Always Better?

by Amarendra Singh and Robert S. Anthony

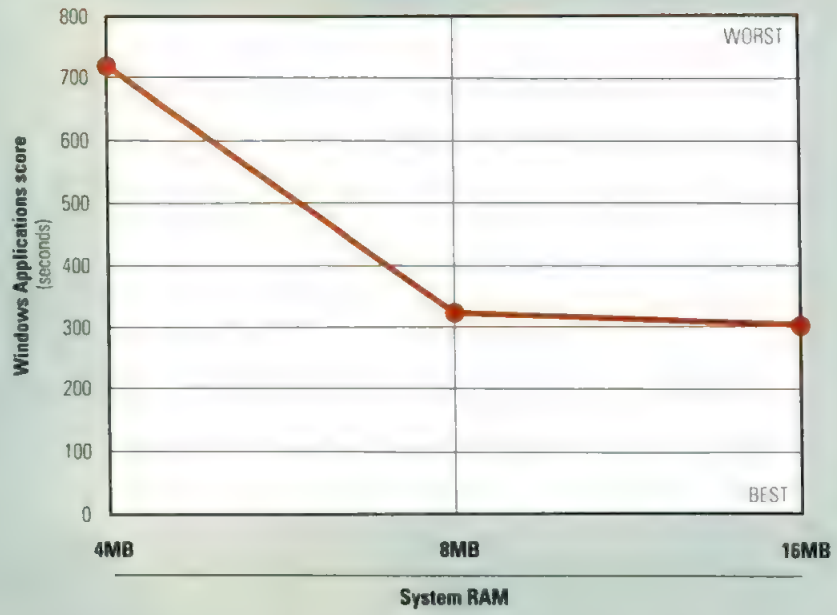
Ever since the debut of the IBM PC, when the 640K DOS memory limit seemed laughably distant, PC users have been adding RAM to their systems to boost performance. More memory is better, but there is a point of diminishing returns. To find this point, we varied the amount of RAM in our test-bed PC each time it ran our Windows Applications test suite, which simulates a multitasking workload.

One of Microsoft Windows' greatest strengths is its ability to use hard disk space as virtual memory, but such disk-based memory is far slower than chip RAM. Also note that in the 4MB RAM configuration, the SmartDrive disk cache defaults to 1MB; this increases to 2MB with 8MB or RAM, thus further reducing disk accesses.

The greatest performance gain occurred when we increased system memory from 4MB to 8MB, which cut the processing time by more than half. The reason is that more application code could now fit into memory, reducing the need for slow, virtual memory. Increasing RAM from 8MB to 16MB only provided minor gains.

Which program benefits most? The Ami Pro section of our test suite accesses data on the disk frequently, and the jump from 4MB to 8MB of RAM cut processing time by more than 80 percent. □

Multitasking with 4MB, 8MB, and 16MB of RAM (no external cache)



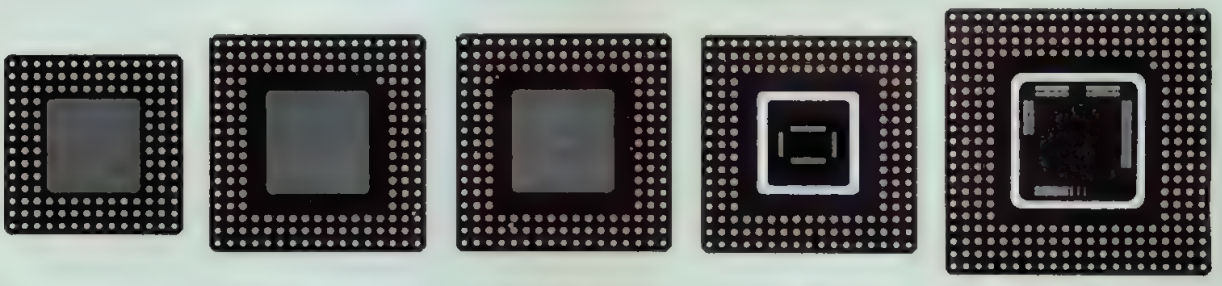
Our test-bed PC's performance on our Windows Applications suite improved sharply when we increased the RAM from 4MB to 8MB. The score did not improve much when we increased it to 16MB; the first 8MB of RAM was the most essential.

HOW WE TESTED

To simulate a multitasking world, we used the four components of our Windows Applications suite: Microsoft Excel 4.0, Ami Pro 3.0, CorelDRAW 3.0, and Superbase for Windows 2.0 in an automated sequence. We loaded the first three into memory, and then we launched Superbase and sent it into the background to perform substantial disk-intensive processing. With Superbase running in the background, we sequentially launched and individually timed the Ami Pro, CorelDRAW, and Excel macros. The Windows Applications score provides a good indication of multitasking performance. We used an ISA-based 486DX2/66 AMI Enterprise III PC with a 120MB Maxtor LXT1234 hard disk and ATI Graphics Ultra Plus video accelerator card with 2MB of video DRAM.

A Pin-by-Pin Approach

Each successive generation of CPU has more pins than the last. The pins provide the only means of communication between the CPU and the motherboard's components, each fulfilling a specific and often unique role. For example, 16 of the additional pins on a 486 chip create the 32-bit data path that the 386 chip did not have. The extra pin on the 486SX CPU disables the chip's built-in math coprocessor, giving the 486 line more flexibility and giving users the speed without the additional cost of a math coprocessor if it really isn't needed. The hundred-plus additional pins on the Pentium processor give it a 64-bit data path, account for the expanded address register, make the dual pipeline possible, and perform dozens of other minute functions that give the new chip its kick.



132-pin 386DX CPU | 169-pin 486SX CPU | 168-pin 486DX CPU | 168-pin 486DX2 CPU | 273-pin Pentium CPU

using 32-bit transfers, MCA could move data at 40 Mbps. Also introduced in 1987 was the Extended Industry Standard Architecture (EISA) bus, which stayed with the 8-MHz speed but boosted throughput with 32-bit transfers. Both Micro Channel and EISA also support bus-mastering, which lets an expansion device take control of the bus to unburden the CPU.

Local-bus designs push potential speeds up to 132 Mbps by linking more directly with the microprocessor's I/O circuitry than do older bus designs. This high speed comes at a penalty, though. The high frequencies that are involved can be compromised by the capacitance of the system's expansion sockets and connecting circuitry, limiting the number

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Playing Cache Up for Performance

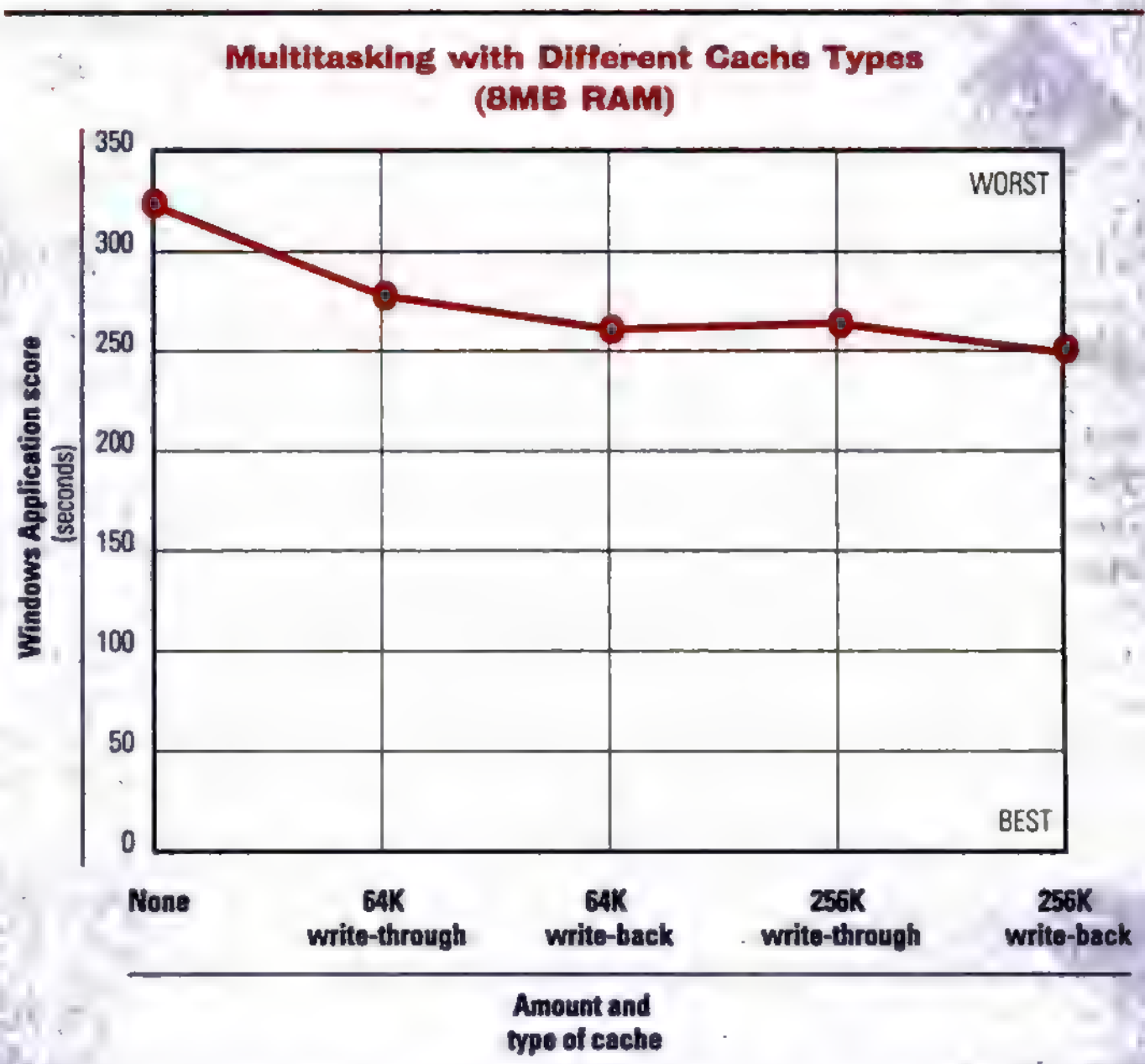
by Amarendra Singh and Robert S. Anthony

When dealing with an external cache, there is a clear advantage to combining the right amount of cache memory and the best design with sufficient system RAM. By using our Windows Applications test suite while trying various combinations of cache size and design, we found that changing cache types or increasing cache memory by themselves reaped relatively small rewards. Both employed together, however, did create a noticeable improvement.

We ran all cache size and write-policy variations with 4MB, 8MB, and 16MB of RAM, and show results for 8MB. While a *write-through* design only caches reads from memory, a *write-back* design caches both data read from and written to memory. The cache size or design had less of a performance impact at smaller RAM levels, because system memory itself was the major performance constraint. As RAM increased and more program code and data could fit into memory, performance improved noticeably.

With 4MB of RAM, the performance gain provided by the external cache configurations, compared with a no-cache situation, ranged from 12 percent with a 64K write-through cache to 17 percent for a 256K write-back cache. At 8MB of RAM, however, the performance gains for the same scenario ranged from 14 percent to 23 percent. With 16MB of RAM, performance increased only slightly.

In essence, while a small external cache is better than none, the differences between the various cache configurations with the same amount of system RAM were minor. The write-back cache performed better than the write-through cache in all cases, and in most instances a 64K write-back cache was equal to if not better than a 256K write-through cache. □



While a small external RAM cache is better than no cache, we found only small performance differences among the four 64K and 256K write-through and write-back designs we tested with our Windows Applications suite. For test-bed information, see the previous chart in this series.

of usable connectors.

Following a multitude of proprietary systems, the first standardized local bus was brought out by the Video Electronics Standards Association (VESA) and termed the VL-Bus. It allows for the connection of three local-bus devices—either on-board circuits (such as video adapters or hard disk IDE host adapters) or expansion slots. Expected this fall, Intel's Peripheral Component Interconnect (PCI) enforces a stricter mechanical design, which potentially allows for a greater number of slots. PCI also makes possible some advanced features, like the support of multiple microprocessors and a multitiered approach to a bus.

Although it is too soon to pick a winner, it is important to note that both the VL-Bus and PCI are designed to work in conjunction with another expansion bus, so a local-bus PC uses both local-bus and more conventional expansion boards. Since VL-Bus provides a higher speed connection than EISA does, imposes no price penalty, and yields sufficient slots for necessary high-speed peripherals, the VL-Bus/ISA combination is adequate for most single-user PCs.

An EISA system (with or without a local bus) is most appropriate for servers requiring multiple network adapters. Some motherboard manufacturers are now avoiding some of EISA's added cost by limiting the number of EISA slots in a product to two or three. Technically there is no reason for the limit—an EISA slot will accommodate all ISA boards that can physically fit—but putting in

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Upgrading Your RAM and CPU

by Oliver Rist

Want a quick and easy speed boost for Microsoft Windows or any other high-octane operating system? The experts will tell you to upgrade your processor and increase your RAM. Fortunately, with the wide use of SIMM chips and Intel's OverDrive upgradable processor line, neither procedure has to be a nightmare.

DROP-IN PROCESSOR POWER

The OverDrive line of CPU chips is designed to fit into the new ZIF (Zero Insertion Force) socket as well as into the older Vacancy sockets (originally meant for a math coprocessor).

Replacing or adding an OverDrive chip to either of these sockets—or even just adding a DX2-type clock-doubling chip to a standard 486 socket—is fairly simple, although the ZIF socket approach is easier because you don't need to handle the CPU as much.

Some PCs, including the Compaq DeskPro M, take an even easier approach by placing the processor on an upgradable plug-in module. These modules look a lot like typical system-expansion cards but usually carry the CPU, the clock crystal, the system BIOS (optional), and the external processor cache (if there is one). The cards plug into a proprietary slot on your motherboard, and the computer will automatically recognize them. Plug in the cards and you're done.

If you don't have an OverDrive socket and your processor is not on a plug-in card, be careful. Unless you're highly confident in your technical abilities, think twice before pulling your CPU. First, it's not that difficult to damage one. Scratching the silicon, bending the connector pins, or subjecting it to an accidental static charge can permanently kill your CPU. Also, before touching your CPU, make sure that you can upgrade both your BIOS and your clock crystal. If you've got a proprietary BIOS from a manufacturer that went out of business, you're out of luck. Similarly, if your clock crystal is soldered onto the motherboard, you're also going nowhere.

As an alternative, you might look into third-party CPU accelerator boards such as those made by SuperComputers (206-881-7500). They are specifically designed for certain systems (Super-

Oh sure, they tell you they've got an accounting system that operates under Windows and has promising new functionality. But before you take the bait, take a closer look.

need retraining and new hardware? When will their product be available? A year from now? Two? Can you wait that long? Furthermore, have their systems been thoroughly tested?

Some accounting tempt you with can be very

Find out if they truly offer a full Windows solution today. Or are they baiting you with a promise? Will it integrate with their DOS product? Is there an easy path to Windows? How much does it cost? Will you

Chances are, you'll discover the technology they're trying to lure you with has more holes than a hunk of Swiss cheese.

Truth is, only Macola Software brings you tomorrow's

Computers boards, for example, are designed solely for AST machines) and install fairly easily, with clear instructions and included drivers.

RAMIFICATIONS

Like your CPU, memory chips are delicate, so take the proper precautions. Be careful to buy the right SIMM chips to work with your system. Their physical characteristics are easy enough to distinguish. Just look at the other SIMMs or the sockets, which can be vertical, low-profile, or right-angle sockets. SIMM chip type and capacity are harder concepts to master.

Basically, you've got three types: 8-bit (Macintosh), 9-bit, and 36-bit. These, in turn come in a variety of different capacities: 256K, 1MB, 2MB, 4MB, 8MB, 16MB, 32MB, and 64MB (the final two are rare or not in production). If you work with a 386SX or lower processor, you're probably running 9-bit SIMMs. Check your documentation or call your vendor to get your memory's complete specifications before purchasing additional RAM. As a rule, 32-bit memory chips must all be of the same type, although you can mix and match some of the 9-bit silicon. But hassle-free upgrading mixing 9-bit chips is not recommended.

The surest way of getting the chips you need is to buy them from your system vendor. Their prices, however, are generally higher than those you'd find from third-party memory vendors. On the other hand, few discount vendors will support you, should anything fail—two that do offer support are are SmartMicro Technologies Inc. (800-266-1576) and Kingston Technology Corp. (800-835-6675).

Once you have your chips, be very careful when you handle them. Try not to touch the silicon, do not bend or break off edges of the plastic, and never attempt to force a chip into a socket. If you are mixing chip types, insert the chip that has the slowest access time into the first bank and the rest of the chips will then run at the speed of the first—configure the chips any other way and your system will crash.

HOW TO . . .

If your SIMMs can fit into its socket in more than one way, match up Pin 1 (usually marked) with the socket's Pin 1 location (also marked). A nifty tool for ensuring the safety of your SIMMs is the SIMM Remover made by Stratos Innovations. This $12.99 ABS-plastic tool will not accumulate a static charge, and it is designed to slide safely over the ends of any SIMM chip. It comes with handy instructions, and can be purchased through a number of selected industry catalogs (like *PC Zone, Mac's Place, Mac Warehouse,* and *Mac Zone*) and retail outlets. □

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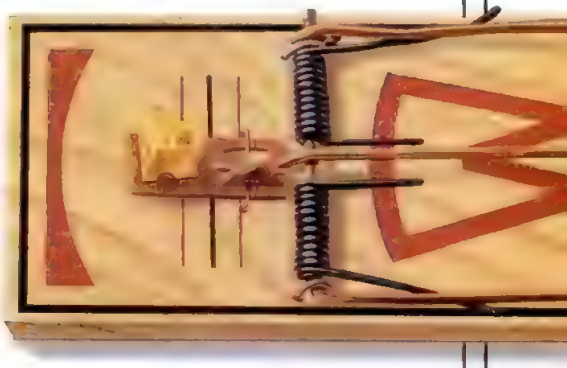

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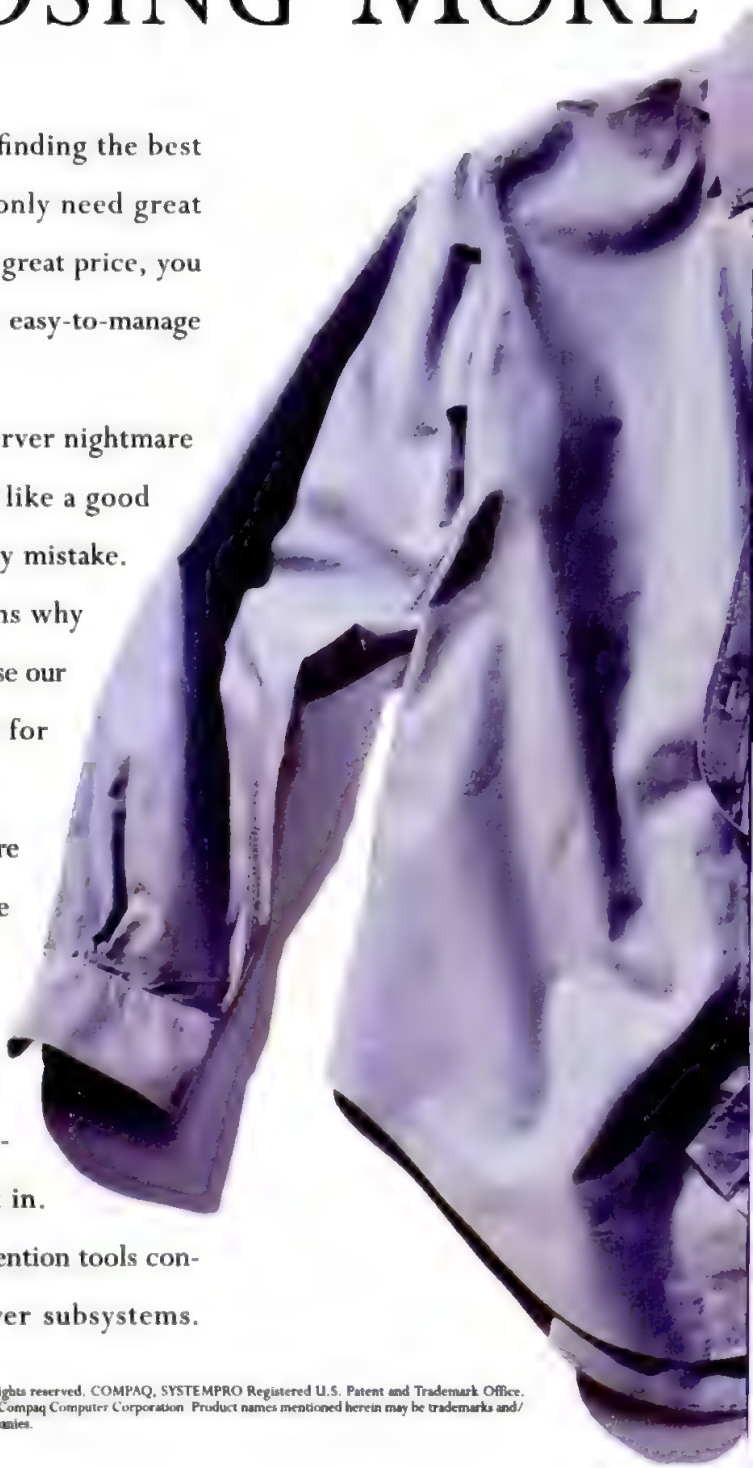

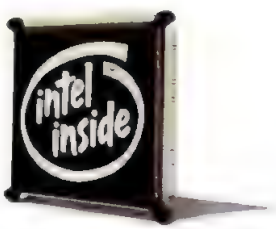

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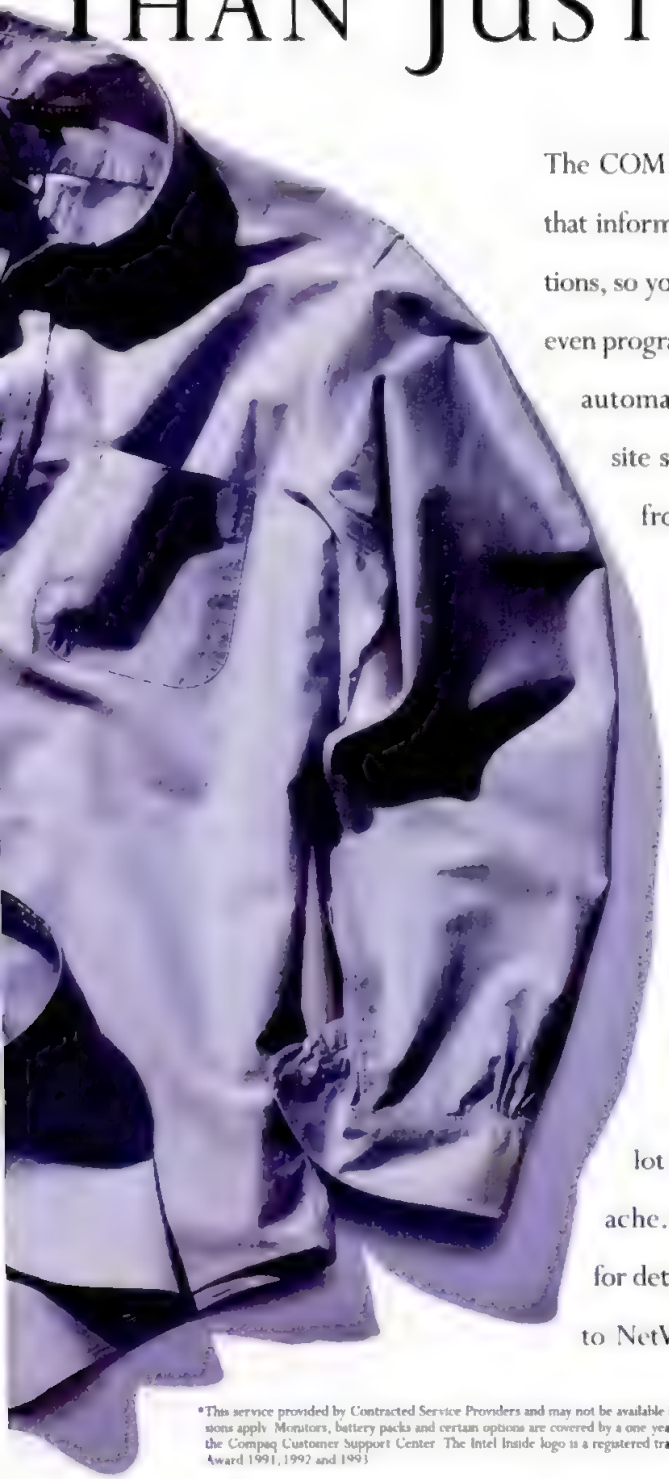

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Little Substitutes:
Pros and Cons of Portable PCs

by Winn L. Rosch

Clever PC makers have crammed nearly every desktop feature—from fax modems to mice—into today's portables. With the sole exception of the new Pentium chip, every Intel microprocessor design has found its way into laptop machines. Laptop technology has progressed to the point at which you can seriously consider taking all of your computing into your own hands and forgoing a desktop PC entirely. The good news is that just about everything you can do on your desktop PC you can now do on your lap. The bad news is that it can be awkward. Portables are machines of compromise, with both advantages and disadvantages.

ADVANTAGES

Size. More compact than most system units, the laptop needs neither an external monitor nor cables. Because everything you need comes in one neat package, there is no longer a need to mix and match peripherals. And you can work anywhere with a laptop machine—from the comfort of a first-class airline seat to the rigorous conditions of a battlefield.

Cost. Although laptops are more costly than desktop machines of equivalent power, a single laptop can do the job of two stationary systems (one at home and one in the office).

Ruggedness. Laptop computers are designed to withstand most of the rigors of travel. Bumps and minor office mishaps, but not an unscheduled trip from the desktop to the floor, don't phase them.

Display. Active-matrix color screens show sharper, clearer images, which helps prevent eyestrain. Fuzzy desktop CRT pixels may cause fatigue, since your eyes constantly refocus in an effort to sharpen the undefined edges of the on-screen image.

Power. A laptop's batteries serve as a built-in uninterruptible power supply. If the AC power in your office fails, your laptop won't go dark. You have hours rather than minutes to finish your work. A desktop machine may consume ten times as much power as a laptop.

DISADVANTAGES

Performance. Many laptops have slower clock speeds to conserve power. They also generally have a smaller memory capacity. High-speed technologies, like the local bus and graphics acceleration, have yet to find their way into mainstream laptops.

Expandability. Laptop PCs limit your expansion options. Only big, luggable machines have ISA expansion slots. While the growing acceptance of PCMCIA may provide standardization, even laptops with PCMCIA slots are generally limited to two of them.

Connectivity. Laptops have few ports and no growth potential. While parallel port–based LAN adapters work, they impose a severe speed penalty (10 megabits per second for bus-connected LAN adapters versus about 300 Kbps for parallel-port adapters). While many laptop makers offer docking stations, these units are clumsy additions.

Ergonomics. Laptop keyboards are taller than desktop designs and usually don't support wrists. Your hands are tilted at possibly painful angles.

Display. Laptop screens are limited to VGA resolution. Passive-matrix screens lack contrast. Although some laptops have outputs for external monitors, few support Super VGA.

Security. Laptop PCs are easier to steal; they can disappear into an attaché case in the blink of an eye.

fewer EISA slots does save about $10 by reducing the number of connectors. You're unlikely to need more than three EISA devices connected in any standalone PC, but with servers, where expansion slots are the coin of the realm, this is another story.

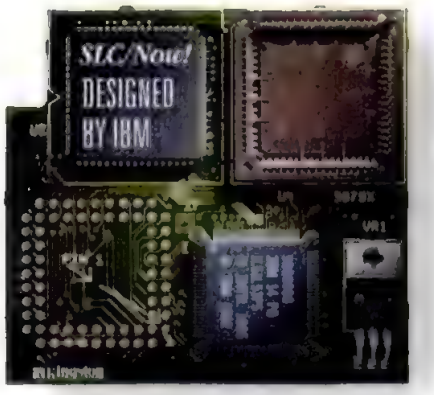
The local bus's effect on the PC landscape so far has been limited to speeding up video performance. Less than a year ago, PC Magazine Labs measured top Graphics Winmark scores of 2 or 3 megapixels per second. Today, the number is at least ten times as high, and the VL-Bus Zeos 486DX2/66 with its Weitek Power 9000 chip set is blasting ahead of the pack, with a Graphics Winmark score of 42 megapixels per second.

The proposed universal expansion standard of laptop PCs, PCMCIA (Personal Computer Memory Card International Association) 2.0, has yet to prove itself. Machines with PCMCIA-compatible slots is increasing faster than the number of peripherals available to plug into them. One reason is the malleability of the PCMCIA standard itself; designed to be usable for any system or operating system, true plug-and-play PCMCIA compatibility has proven elusive.

However, almost every PCMCIA card requires one or more software drivers, which confuses you and your system. The bottom line is that PCMCIA has enormous potential, but its value is more theoretical than practical. Nothing prevents desktop PCs from incorporating PCMCIA slots, and by late summer, a major vendor says it will offer a PCMCIA adapter for existing desktop PCs.

POWERFUL CHOICES

Power is important but no longer an issue with today's PCs. In fact, you could stuff a system with all the features necessary for a network server and not strain the once-inadequate reserves of the first PC's 63.5-watt power supply. Today's 1GB hard disks draw only about 15 watts, and the fastest microprocessors about 5 to 10 watts. The largest expansion boards rarely draw more than 5 watts. The smallest power supply you're likely to encounter in today's PCs is 75 to 100 watts, so you won't have to worry about a power shortage. Twice this number is a good starting point for a file server.



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Landmark Speed 2.0: Recount: Retail Price:	8 MHz 5:44 Min.	35 MHz 1:51 Min. $215	22 MHz 1:54 Min. $1,545	286-based systems from AST, Compaq, Epson, Everex, Hewlett-Packard, IBM, NEC, Toshiba and Zenith
SLC/Now!	PS/2 Model 50	With SLC/Now!	PS/2 Model	SLC/Now!
Landmark Speed 2.0: Recount: Retail Price:	13 MHz 3:34 Min.	114 MHz :29 Sec. $425	84 MHz :38 Sec. $3,280	IBM PS/2 Models 50, 50Z and 60
486/Now!	PS/2 Model 70 (25MHz)	With 486/Now! SX 25	PS/2 Model	486/Now!
Landmark Speed 2.0: Recount: Retail Price:	39 MHz :55 Sec.	84 MHz :39 Sec. $495	84 MHz :38 Sec. $3,280	IBM PS/2 Models 70 and 80, Compaq Deskpro Models 386/16, 386/20, 386/20e, 386/25, 386/25e, 486/33
MCMaster	PS/2 Model	With MCMaster SX 25	PS/2 Model	MCMaster
Landmark Speed 2.0: Recount: Retail Price:	16 MHz 2:47 Min.	84 MHz :36 Sec. $795	84 MHz :38 Sec. $3,280	IBM PS/2 Models 55, 56, 57, 65, 70, 80 and 90

All systems tested with 16MB installed except MCMaster tested with 8MB on-board and 8MB on mother board. All system prices are MSRP at standard configuration as of 6/1/93. Processor upgrade prices are MSRP as of 6/1/93. Recount conducted on 3MB Excel for Windows spreadsheet generated by Kingston Technology

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As mundane as a metal box might seem, your choice of chassis and cabinet for your PC dramatically affects where your PC fits into your life—both physically and in terms of what applications it can run. The wrong box limits your expansion choices or may overwhelm your workspace. The case for getting the right case is compelling. Among desktop PCs, you have a multitude of choices: full-size and compact towers, full-size and small-footprint desktops.

Tower-style cases align the plane of the motherboard and hence the vertical axis of the machine. The machine stands on end, like a skyscraper occupying a small parcel of floor space. Freed from the constraint of desktop real estate, towers are often designed with prodigious expansion accommodations. Most have at least eight slots and at least six drive bays. Everything you might want to install in a PC will fit somewhere. Desktop units are typically the basis for pricing, and a tower can cost about $100 more.

A compromise is the compact tower. While often attractively styled, most compact towers offer modest expansion room—typically two half-height 5.25-inch drive bays and two 3.5-inch bays. That's on a par with a small-footprint desktop PC, although the compact tower is likely to hold eight expansion slots. As compelling as they may be for their modernity and modest desktop impact, all compact cases suffer several drawbacks. Typically, they have fewer expansion slots (only three for many small-footprint machines), fewer and smaller drive bays, and proprietary motherboard sizes.

The last issue is important if you ever want to upgrade your PC's motherboard (to add a local-bus subsystem, for example). You can readily find inexpensive AT- and XT-size replacement motherboards. Fitting one into a small-footprint case requires ingenuity and a metal shop.

Most manufacturers of compact PCs minimize the number of slots they believe you need by incorporating functions on the motherboards, but the location limits your future choices. For instance, if you bought a PC last year with SCSI and video on the motherboard, your PC will be forever blocked from high-speed local-bus connections.

Before buying a compact PC, be sure you'll get enough 5.25-inch drive bays for all your future expansion needs. Several peripherals will never fit into 3.5-inch bays, because of the size of the media they use. These include 5.25-inch floppy disks, CD-ROM drives, WORM drives, 5.25-inch magneto-optical drives, most removable-cartridge magnetic drives (including Iomega's Bernoulli Boxes and most SyQuest cartridges), and most network-size tape backup systems such as DC-6000 and 8-mm units.

As with any major purchase you will have to live with for many years, the most important considerations are to plan ahead, assess your needs, and plan for the future. Most dreams rarely last for more than a night, but with adequate planning your perfect PC could fulfill your dreams for years to come. □

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The PERFECT DISPLAY

NO PC IS PERFECT WITHOUT THE RIGHT MONITOR AND GRAPHICS BOARD. THIS OVERVIEW WILL HELP YOU CHOOSE THE IDEAL VIDEO COMPONENTS.

BY ALFRED POOR

The video display adapter and monitor are two pieces of the perfect PC you should want to get as perfect as possible. Because the video display is the main portal through which you interact with your computer, choosing the right components will enhance your productivity as well as your pleasure.

Slight performance differences in other components may be imperceptible—such as milliseconds of access speed for a hard disk, or a few ticks' difference between two inconceivably fast chip clocks. But get a display that drags instead of quickly popping clear new images in front of you and you will rapidly become a frustrated user suffering from impatience and eyestrain.

VIDEO ADAPTERS

The video adapter in your computer has one purpose: to take data and convert it from digital bits into a signal that can be transmitted across wires to the monitor (which then interprets the signals to create an image on its screen). Although this task is simple to describe, its execution is complex.

Part of the problem is the immense amount of data involved in computer dis-

Video Memory: How Much Do You Need?

Resolution	Color depth (bits)	Number of colors	Minimum RAM (megabytes)
640 x 480	4	16	0.25
640 x 480	8	256	0.50
640 x 480	16	65,536	1.00
640 x 480	24	16,777,216	1.00
800 x 600	4	16	0.25
800 x 600	8	256	0.50
800 x 600	16	65,536	1.00
800 x 600	24	16,777,216	1.50
1,024 x 768	4	16	0.50
1,024 x 768	8	256	1.00
1,024 x 768	16	65,536	1.50
1,024 x 768	24	16,777,216	2.50
1,280 x 1,024	4	16	1.00
1,280 x 1,024	8	256	1.50
1,280 x 1,024	16	65,536	2.50
1,280 x 1,024	24	16,777,216	4.00
1,600 x 1,200	4	16	1.00
1,600 x 1,200	8	256	2.00
1,600 x 1,200	16	65,536	4.00
1,600 x 1,200	24	16,777,216	6.00

play technology. Computer images are made up of rows of illuminated dots called *pixels* (picture elements). The original Color Graphics Array (CGA) display could show either 320- by 200-pixel screens in four colors, or 640- by 200-pixel screens in black and white. The screens comprised only 128,000 bits, or 15.6 kilobits, of data. A 1,024- by 768-pixel display capable of showing 256 colors (in 8-bit color) requires 786Kb of data, or nearly 50 times as much data as a CGA image. Increase the display load to 24-bit full color and the amount of data triples to 2.3MB per screen.

That's a lot of data to move around in a hurry, especially when you consider that the Video Electronics Standards Association (VESA) recommends a refresh rate of at least 70 complete frames per second (70 Hz) to reduce monitor flicker.

RECENT EDITORS' CHOICES

Video Adapters

"Video Cards Revisited" (current issue)
- *Diamond Stealth Pro*
- *Hercules Graphite Card*

"Graphics Accelerators: Waking Up Windows" (April 13, 1993)
- *Actix GraphicsEngine Ultra*
- *ATI Graphics Ultra Pro, EISA Version*
- *Orchid Fahrenheit VA*

"Video Technology: Making a Choice in an Era of Change" (January 12, 1993)
- *ATI Graphics Ultra Plus*
- *Metheus Premier 1280NI*
- *NDI Volante AT600 Plus*

Monitors

"14- and 15-Inch Monitors: Mainstream Choices" (March 16, 1993)
- *ADI MicroScan 3E+*
- *MAG MX15F*
- *Nanao Flexscan F340iW*
- *NEC MultiSync 4FG*
- *Optiquest 1500D*

"17-Inch Displays: A Better View of Windows" (June 30, 1992)
- *MAG MX17F*
- *Nanao Flexscan F550i*

PLAYING THE CHIPS

One of the most important factors in video adapter design is the type of processor used to manage all the data. In general, video cards use one of three types of chips: frame buffer, fixed-function accelerator, or programmable coprocessor. For most PC users' needs, accelerator cards are the appropriate choice.

A *frame buffer*, which is the oldest and simplest chip design, requires the computer's CPU to calculate the data for each pixel on the screen and to send that data to the video card. The frame buffer holds the data as it is converted into analog signals that are sent to the monitor. Although current frame buffers have some features that improve performance—such as pipeline cache for instructions—they are generally slower than accelerators and coprocessors.

Accelerator chips take a different approach. Their designers recognized that many display processes make heavy use of specific operations, such as drawing line segments or filling areas of the screen with a pattern. Accelerators are nonprogrammable processors that take control of video processing from a computer's CPU. Because they are dedicated to handling video functions, accelerator chips can process data as fast as a CPU can or faster. This enables the CPU to handle less information—short commands rather than the complete screen data—and reduces the data transfer time from the CPU to the video card.

A software program called a *driver* is used to orchestrate this process, and manufacturers include drivers with their boards. (Drivers typically are updated throughout a board's life; see "Sources for Up-to-Date Windows 3.1 Drivers" for vendor support information.)

Coprocessors offer a more flexible approach. Because these chips are programmable, a software driver can control how the video board performs calculations—which allows drivers to be tuned for specific applications. A coprocessor accepts a stream of commands from the computer's CPU and assumes a large portion of the processing load.

Video boards are based on one of these three chip types. In general, frame buffer cards are least expensive, coprocessors are most expensive, and accelerators occupy the middle tier—but there are exceptions. One factor that affects video board prices is whether the board uses DRAM or VRAM. Most cards use DRAM, which is less expensive but has only a single pipeline through which it receives and sends data. VRAM, which is more expensive, can receive and send data simultaneously via dual pipelines, thus improving performance.

THE BUS QUESTION

The price of a video system is also affected by the type of bus used on the video card—ISA, EISA, Micro Channel, or local bus. The growing popularity of the VESA local-bus (VL-Bus) standard means that you can find ISA and EISA motherboards that offer one or more VL-Bus slots.

An ISA bus is only 16 bits wide and typically runs at 8.33 MHz. EISA and Micro Channel buses are 32 bits wide and also run in the 8- to 10-MHz range. The VL-Bus specification is 32 bits wide but has the added advantage of running at the system's bus speed, up to a maximum of 40 MHz.

So what is the perfect video adapter for your perfect PC? To help answer this question, we ran benchmark tests on a representative sample of video boards, including frame buffer, accelerator, and video coprocessor models. We examined ISA, EISA, and VL-Bus performance, and tested cards that used DRAM and VRAM. We even tested cards on slow (486SX/25) and fast (486DX2/66) PCs to determine whether CPU speed made a difference.

Although the sample of cards tested was small, the tests provided enough evidence to make useful assumptions. For

Our Contributors: ALFRED POOR is a contributing editor to *PC Magazine*. MICHAEL NEUBARTH was the associate editor in charge of this story, and JONATHAN HILL was the project leader.

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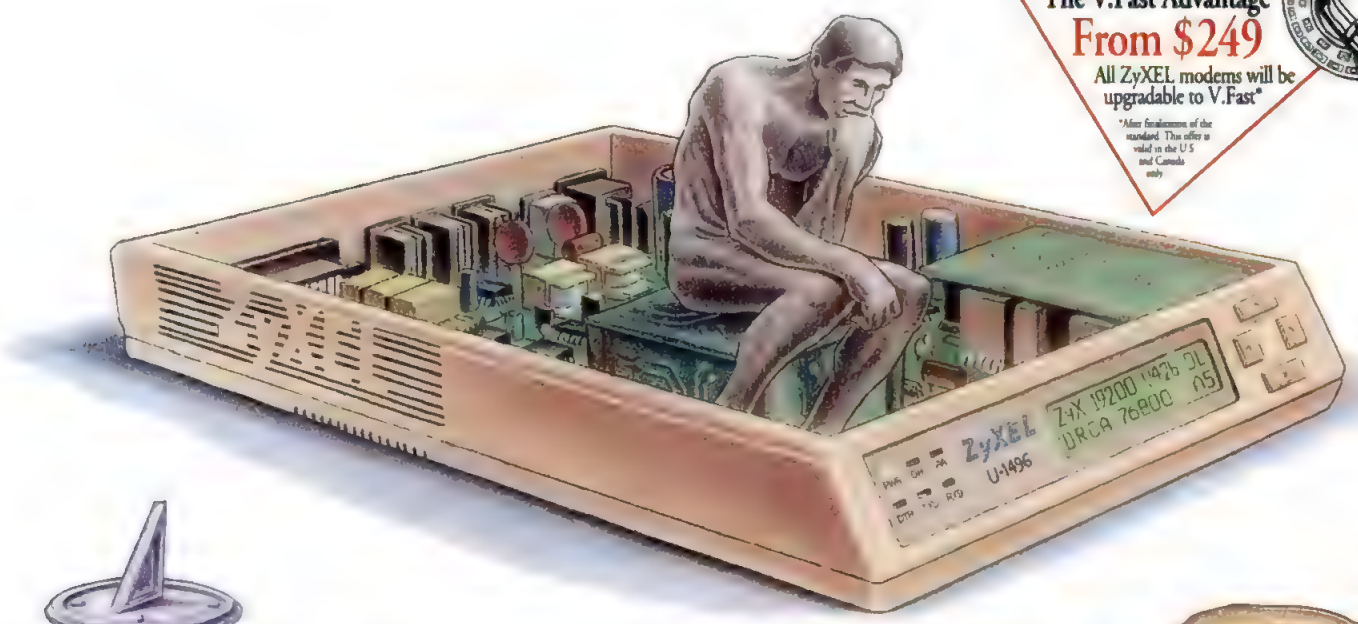

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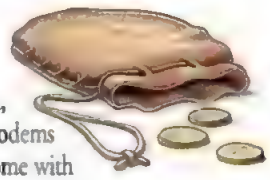

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HIGHLIGHTS

The Perfect Video Display

THE MONITOR and video adapter are among the most important components of your PC and should be chosen carefully. For the perfect PC dream machine, a 20-inch high-resolution monitor and a top-flight accelerator card are ideal. For a Windows workstation, an accelerator card and a 17-inch monitor are the perfect combo. Server video requirements can often be met by inexpensive monochrome displays.

VIDEO ADAPTERS come in three varieties based on the type of chip used: frame buffer, accelerator, or coprocessor. For most Microsoft Windows users, an accelerator card is the most appropriate choice because it provides all the needed performance at a reasonable price. Frame buffers generally are best suited for DOS PCs, while coprocessors are appropriate for high-end, true-color processing.

OUR VIDEO BOARD tests showed that CPU speed has a major impact on video performance, and that upgrading to a faster processor is one of the best ways in which to dramatically improve video performance. The bus type (ISA, EISA, or local bus) was not nearly as significant a factor.

VRAM proved slightly better than DRAM at enhancing video performance within a particular set of parameters (midrange resolution and color depth), and was better at providing fast refresh rates for high-resolution, true-color video processing. Video boards have a much harder time handling more colors than they do maintaining performance at higher resolutions.

IN CHOOSING a monitor, users should seek the largest, highest-resolution, multifrequency display possible, which should be driven by an accelerated video board that mates well with the monitor. For most Windows users, great video can be had at 1,024-by-768 resolution with 256 colors. Noninterlaced models with high refresh rates and a tiny dot pitch are preferable.

example, we found that cards that boosted Windows performance did not necessarily increase DOS performance. Our tests indicated that for most users' video requirements, VRAM boards offer little advantage over DRAM boards. We also found that increasing CPU speed dramatically improved Windows performance (as much as 300 percent).

We did not test the boards across a wide gamut of applications. Graphics-intensive applications like CAD programs have special video processing requirements that might be better served by other products (CAD packages often use display drivers that enable them to take advantage of the processing capabilities of particular chips).

STACKING THE CHIPS

The best results for DOS speed were posted by cards based on Tseng Laboratories' Tseng ET4000 frame buffer. The fastest time was garnered by the accelerated W32 version of the chip. We found that CPU speed affected the performance of VL-Bus cards more than that of ISA or EISA cards. So for optimum DOS speed, users should consider a quality frame buffer like that in the Tseng ET4000 cards.

The results were different for Windows. The top performer was the VL-Bus board incorporating a Weitek Power9000 accelerator chip. With a fast CPU, it was way ahead of the other cards in Graphics Winmark performance. Other board results were also greatly affected by CPU speed; VL-Bus cards with ATI mach 32, S3 928, TI34020, and Tseng ET4000/W32 chips all were faster when driven by a 66-MHz CPU.

We also found that color depth had a significant effect on Windows performance. For example, at the same resolution (640 by 480 pixels), the Weitek Power9000's Winmark score dropped rapidly as the color depth was increased from 256 to 64,000 and then to 16.7 million colors. The ATI mach 32 board was not as fast as the Weitek board at 256 colors, but it maintained more of its speed at the 64,000-color level. At 16.7 million colors, the Weitek board was the fastest performer overall.

One might also expect vertical refresh rate and resolution to affect video card performance significantly, but our tests showed otherwise. At 800-by-600 resolution, there were only small differences as the refresh rate was changed from 60 Hz to 72 Hz. A given board's Winmark score with 256 colors at 640-by-480 resolution changed little when the resolution was raised to 1,024-by-768. While one VL-Bus board's performance with an S3 928 accelerator dropped rapidly at 1,280-by-

VESA Monitor Timing Standards

Resolution	Refresh Rate	Adoption date of VESA standard
640 x 480	72 Hz	November 11, 1990
800 x 600	72 Hz	June 2, 1990
1,024 x 768	70 Hz	August 9, 1991

Above are the Video Electronics Standards Association (VESA) refresh standards, designed to eliminate flicker on multifrequency, high-resolution monitors. In addition to these standard refresh rates, VESA has published monitor timing guidelines to ensure that all VESA-compliant products will work together (56 Hz for 640-by-480, 60 Hz for 800-by-600 and 1,024-by-768). Because these are only minimum requirements, *PC Magazine* recommends adherence to the standards rather than the guidelines.

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1.44MB FDD	•	•	•	•	•
1.2MB FDD			•	•	•
32 Bit VESA Local Bus Slots		Yes/2	Yes/2	Yes/2	Yes/2
14" 1024x768 Monitor	•	•	•	•	•
Mini Desktop Case	•	•	•	•	•
RAM Expandable to 32MB	•	•	•	•	•
Write through RAM cache expands to 256K	•	•	•	•	•
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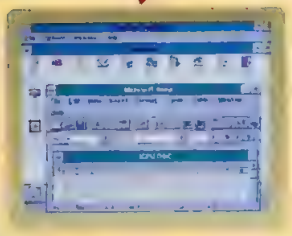
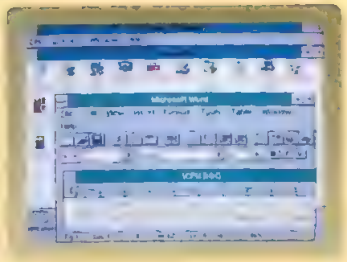
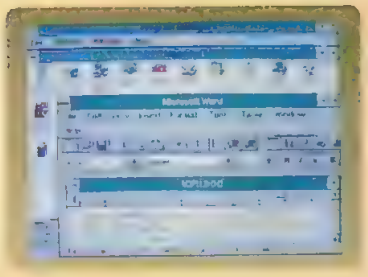
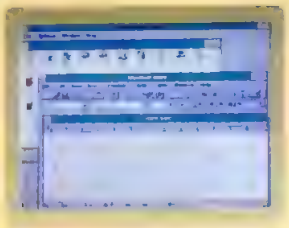
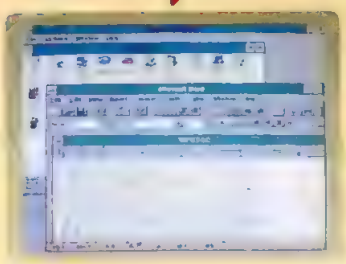
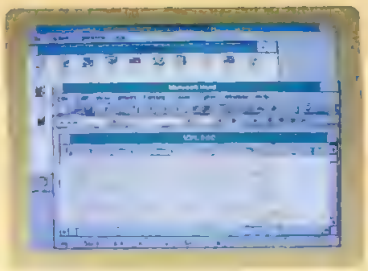
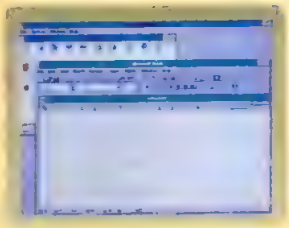
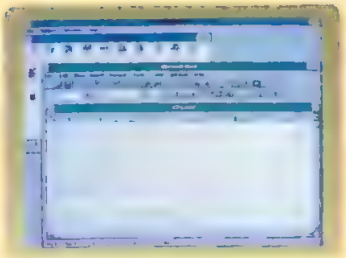
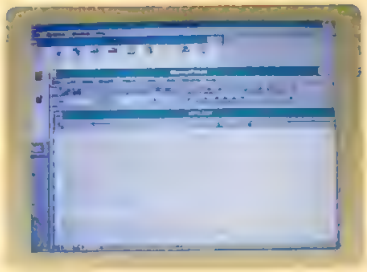
Stretching the Screen:

Monitor Size and Resolution

These photos illustrate how increasing the on-screen resolution in Microsoft Windows affects the image on monitors of different sizes (14, 17, and 21 inches). As resolution rises, more information can be displayed in greater detail (more pixels per inch), but the information shrinks in size. Some shrinkage (of icon titles, text, and so on) can be offset by changing Windows settings and installing special fonts, but Windows icon and menu sizes cannot be easily altered. Some applications and graphics display adapter drivers offer zoom features that can enlarge information while retaining resolution.

Monitor size

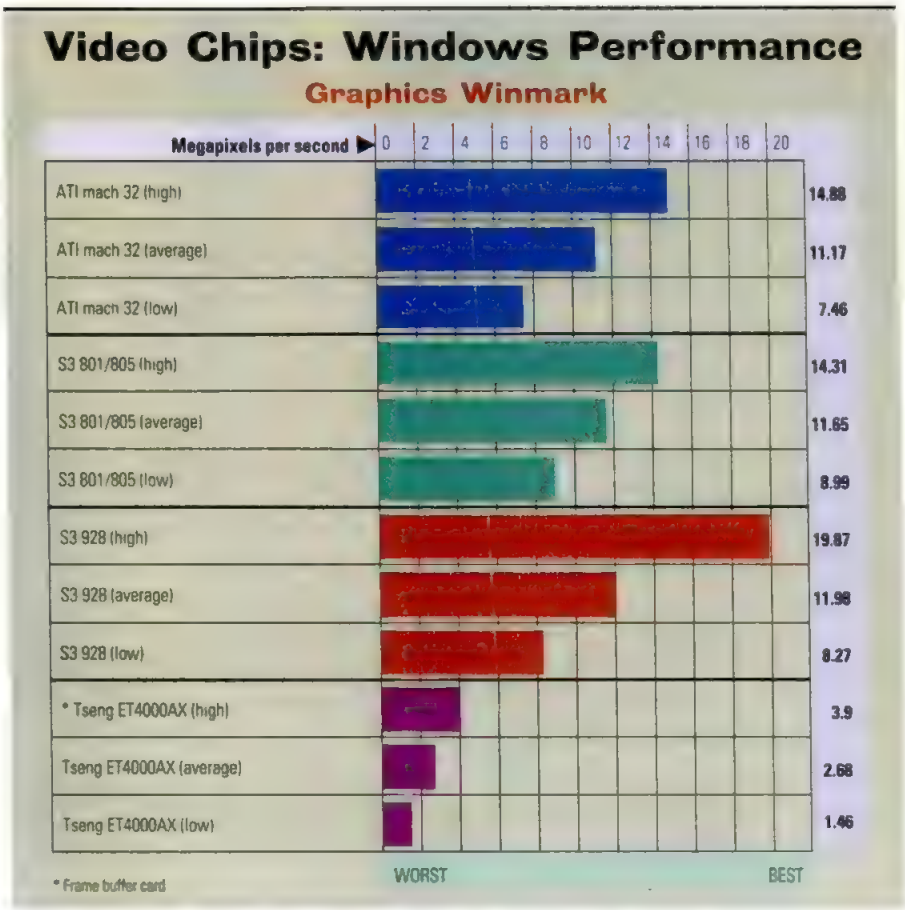
	14"	17"	21"
640 X 480	✔ 		
800 X 600		✔ 	
			✔ 

✔ = Good match

1,024 resolution, this was the exception even at this high resolution. But our tests measured pure horsepower (pixel processing speed), and increasing the pixel load a card must handle can yield slower visual results on the monitor.

In evaluating the effect of VRAM versus DRAM on Windows performance, we found that within "midrange" user parameters (800-by-600 resolution with 256 colors), VRAM boards were slightly (about 5 percent) better able to maintain higher refresh rates. Our results indicate that VRAM generally can provide better support for more demanding video loads (true color, high resolution).

We found that the VL-Bus cards on the average were faster than the ISA or EISA cards (at 1,024-by-768 resolution with 16 or 256 colors, and at 640-by-480 resolution with 64,000 or 16.7 million colors). But ISA and EISA cards can achieve exceptional performance levels because of the power of their accelerator and coprocessor chips. The data path between the CPU and the graphics adapter can be a limiting factor (or *bottleneck*) in graphics operations. This is particularly true for "dumb" frame buffers, which require a greater interchange of data with the CPU than more intelligent accelerators and coprocessors do. High-speed coprocessors show less dramatic performance gains in VL-Bus implementations because they perform more operations themselves and rely less on the bus for exchanging data with the CPU.



THE PERFECT VIDEO ADAPTER

If the dream machine version of your perfect PC will be used mostly for Windows applications, a VL-Bus board with an accelerator chip looks like the best choice. Judging from our results, a board using a Weitek Power9000 chip makes an excellent candidate. But vendors' products are continually leapfrogging each other in performance, so keep an eye out for several hot new chips on the verge of release (from Appian Technology, Matrox Electronic Systems, and Tseng Laboratories, to name a few). You also should couple a fast video board with as fast a system CPU as possible for maximum performance.

For a Windows workstation, the same advice holds: Use a VL-Bus accelerator board in tandem with a fast CPU. If you cannot afford a system with a fast CPU, consider boards based on the ATI mach 32, S3 928, or Tseng ET4000/W32 chips.

The SOHO (small office, home office) machine should be expected to run either DOS or Windows applications, and again the VL-Bus boards posted the best results. The board with the best combined DOS and Windows performance was based on the Tseng ET4000/W32 accelerator, which ran DOS faster with a slow CPU than the other boards did with a fast CPU. The Tseng frame-buffer design in the ET4000 series was a close second in running DOS apps, especially when paired with a fast processor.

For a LAN server, video is relatively unimportant. Most server display requirements are text-only, for which a monochrome adapter will suffice. You can pair a monochrome adapter with an inexpensive monochrome monitor and spend less than the cost of most SVGA video cards. If you are setting up a nondedicated server, or if your server software needs a more sophisticated display, the SOHO machine's recommendations will most probably fit the bill.

THE PERFECT MONITOR

Besides printer output or the occasional beep from your PC's speaker, the only way you gain access to what's going on inside your computer is through the monitor. In fact, the device's name is derived from its function: It enables you to monitor what is going on inside your system.

Although there are many display technologies, PCs typically use cathode ray tube (CRT) displays, which, even with drawbacks is the most cost-effective design for producing bright, stable images.

So what is the perfect monitor for the perfect PC? While there is no clear-cut answer, there are a few guiding principles that can make the choice easier. The first specifications to consider in selecting a monitor are the horizontal and vertical scan frequencies and the bandwidth.

RESOLUTION AND FLICKER

One of the most important features of a monitor is its resolution, which is the

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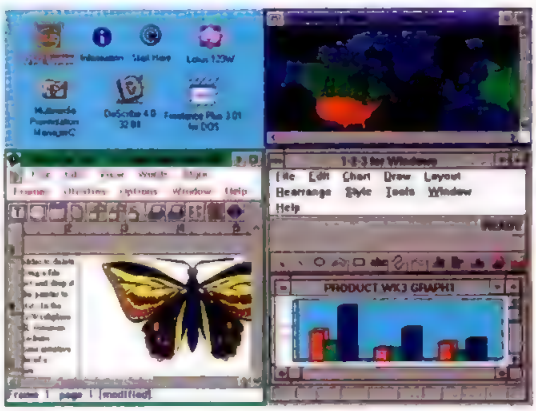

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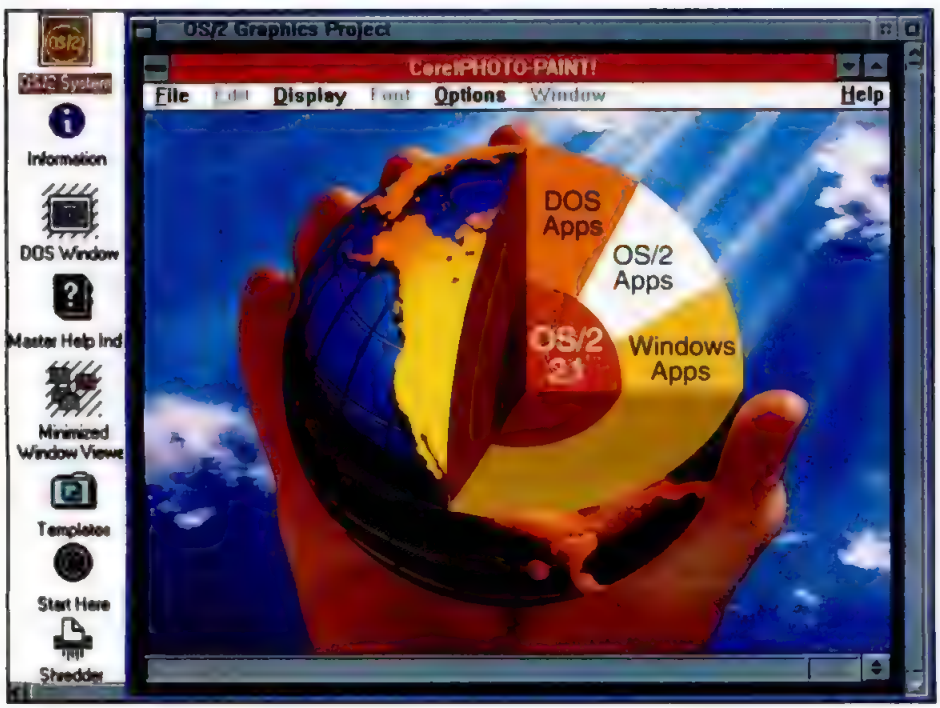

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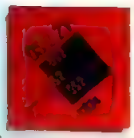

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CIRCLE 131 ON READER SERVICE CARD

Although our tests showed that a VRAM-based board with a local bus could boost PC video performance, we found that the most dramatic way to improve Windows graphics performance is to upgrade your CPU. And the best way to bring your system to its knees is to increase the number of colors it has to handle.

What the Numbers Mean

RESOLUTION

The Graphics Winmark scores were almost unaffected when we increased the video resolution at 256 colors. Note that our Winmark scores are reported in megapixels per second (a megapixel is 1,048,576 pixels). The number of pixels on-screen increases substantially as the resolution increases: 640 x 480 = 307,200 pixels, while 1,024 x 768 = 786,432 pixels. Thus, any perceived drop in performance as you increase the resolution is caused by the heavier pixel load the chip must process.

COLOR DEPTH

Almost all the boards we tested could handle 256 colors (8 bits/pixel) at or near the same rate as 16 colors (4 bits/pixel). When we switched to 64,000 colors (16 bits/pixel), performance degradation averaged 50 percent. At 16.7 million colors (24 bits/pixel), performance dropped another 80 percent.

BUS

Local-bus video has been touted as the panacea for graphics performance problems. The VESA VL-Bus (local bus) is a 32-bit bus at system clock speeds up to 40 MHz, but this technology helps to alleviate performance bottlenecks only at the bus itself. There is considerable performance overlap among buses.

The performance advantage of EISA and local buses is only apparent with 64,000 colors or more. At all other resolution/color combinations, the best ISA cards outperform the worst VL-Bus cards. And the EISA cards we tested showed little or no performance advantage over their ISA counterparts. Although the VL-Bus has inherent architectural advantages for moving data, when we were able to make direct comparisons between ISA and VL-Bus implementations of the same graphics chip, we typically saw only small improvements (about 2 to 3 megapixels per second). Newer board designs, like the Weitek Power9000–based cards, can use the faster, wider bus to achieve superior performance. In working beyond 64,000 colors, you will want every possible performance boost.

FAST OR SLOW CPU

While upgrading to a faster CPU yielded dramatic performance improvements for Windows graphics, DOS video performance showed less substantial increases using a faster CPU. In general, local-bus cards scored significantly better than ISA or EISA cards did on our DOS video tests. VL-Bus cards also yielded relatively large gains (12 to 60 percent) when the CPU speed was increased.

The exception was the Weitek Power9000–based Cardinal Warpspeed, which requires a separate chip to process VGA video. This VL-Bus card's DOS video scores were indistinguishable from those of most ISA and EISA cards.

In Windows, the only boards relatively unaffected by CPU speed, such as Texas Instruments' TI 34020, used coprocessor technology; all others improved notably. In short, upgrading the CPU is generally the most significant enhancement users can make to improve Windows performance.

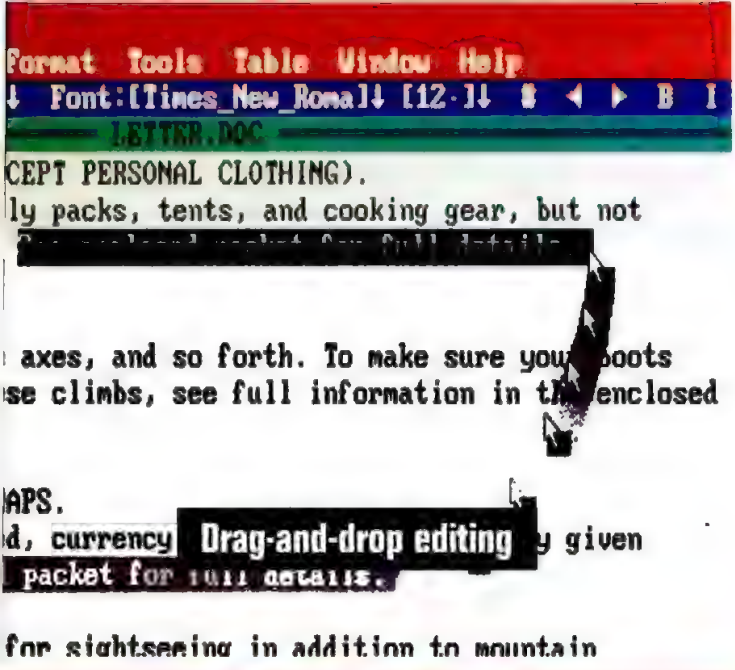
DRAM/VRAM REFRESH RATES

"VRAM is better than DRAM" has become a mantra in the industry. DRAM is certainly cheaper than VRAM, but VRAM's dual-port design makes it easier for board manufacturers to maintain refresh rates and performance at high resolutions and color depths. We looked at the changes in performance for DRAM and VRAM boards as we increased the refresh rate from 60 to 72 Hz, always using 800-by-600 resolution with 256 colors. The results (not shown in our charts) indicated that the VRAM boards maintained their performance when the refresh rate was increased, while DRAM boards' scores decreased by 3 to 5 percent. This was not a dramatic result, so we tried increasing the color depth. With 64,000 colors, the DRAM boards would not refresh at 72 Hz, and instead stepped down to 60 Hz, apparently recognizing that the DRAM was not able to update the screen fast enough to display at the higher refresh rate recommended by VESA (we found nothing in the boards' documentation that addressed this).

When raised to the higher color depth and refresh rate, the VRAM-based S3 928 boards maintained the 72-Hz rate, but the lower parts of the screen developed noticeable flicker. If you do a lot of work at true color depths, you may have to work at lower refresh rates.

How We Tested

Our test-bed for video boards consisted of OEM units from AMI based on its new upgradable EISA/VL-Bus motherboard—one of the first with an EISA/VL-Bus slot—which allowed us to test ISA, EISA, and VL-Bus graphics boards in the same machine while varying the processor type. The units came with 8MB RAM, 40MB hard disks (more than enough for our testing purposes), and 256K of Level 2 processor cache. Our "fast" CPU was an Intel 486DX2/66, while our "slow" one was an Intel 486SX/25. We used PC Labs' DOS video and Graphics Winmark tests to gauge the effects of increasing resolution and color depth, varying bus type (ISA, EISA, or VL-Bus), varying CPU, and using DRAM versus VRAM. Except as noted, we ran all tests at a 60-Hz refresh rate.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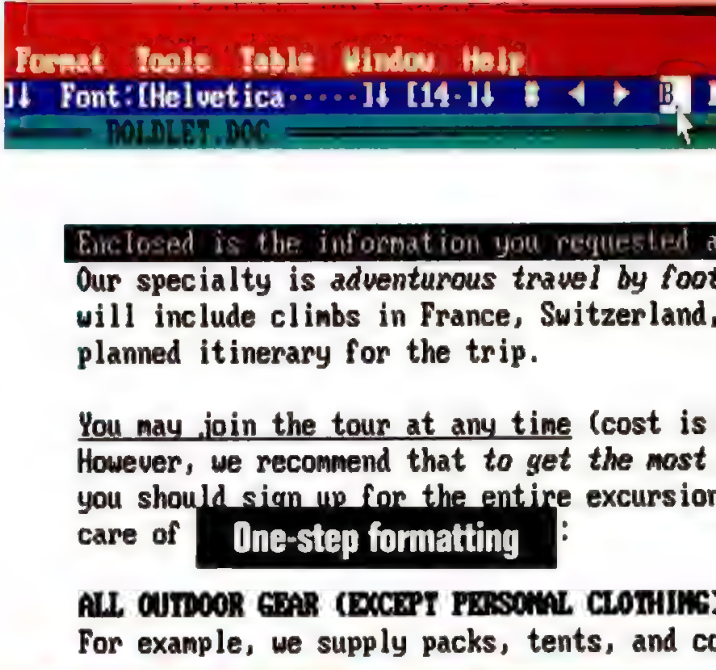
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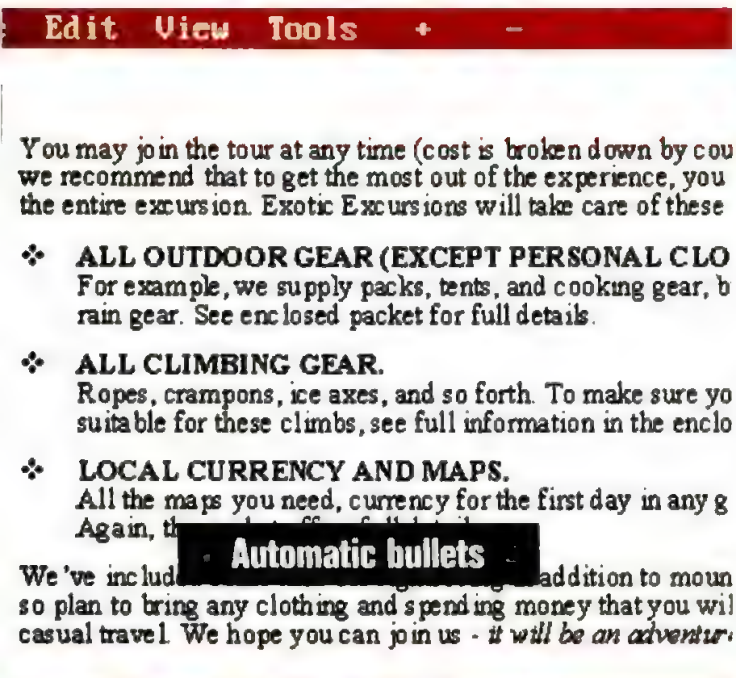
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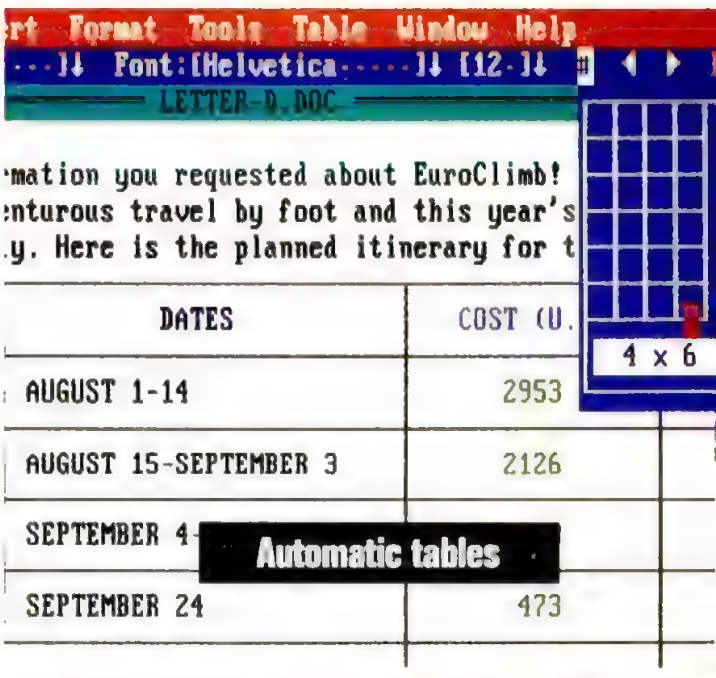
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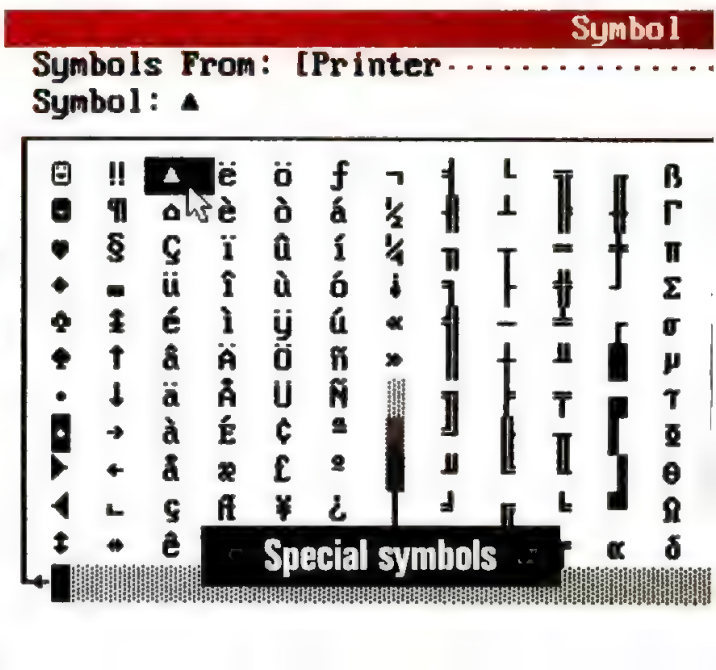
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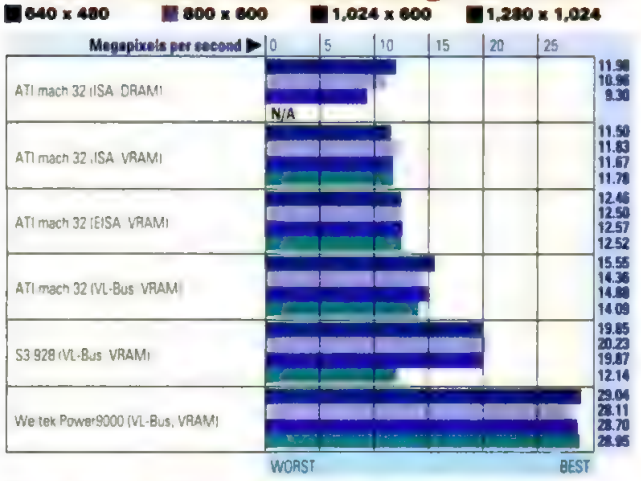
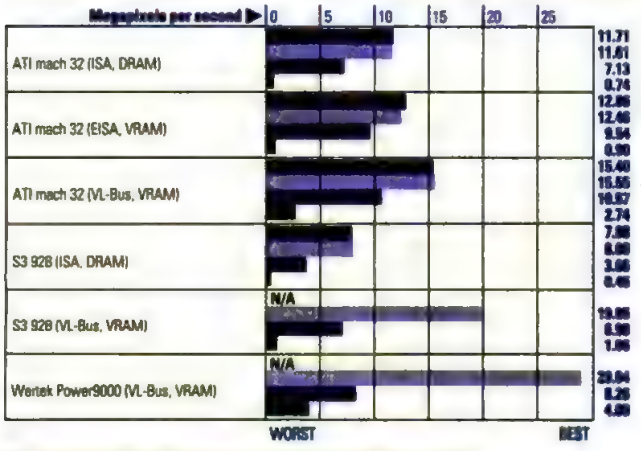
GRAPHICS WINMARK

256 Colors, with Increasing Resolution



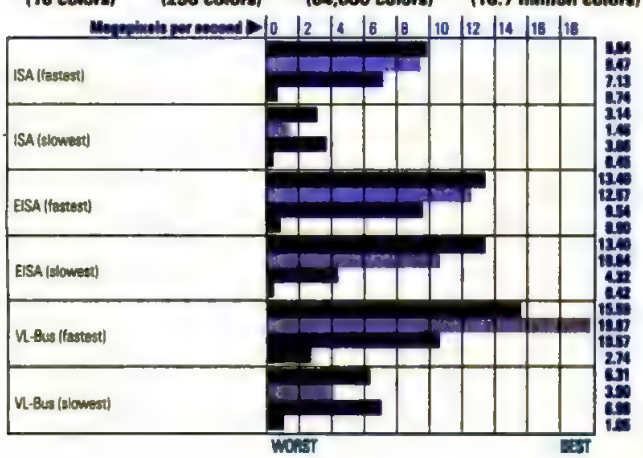
N/A— Not applicable. The board does not support this resolution and color depth

640 x 480, with Increasing Color Depth

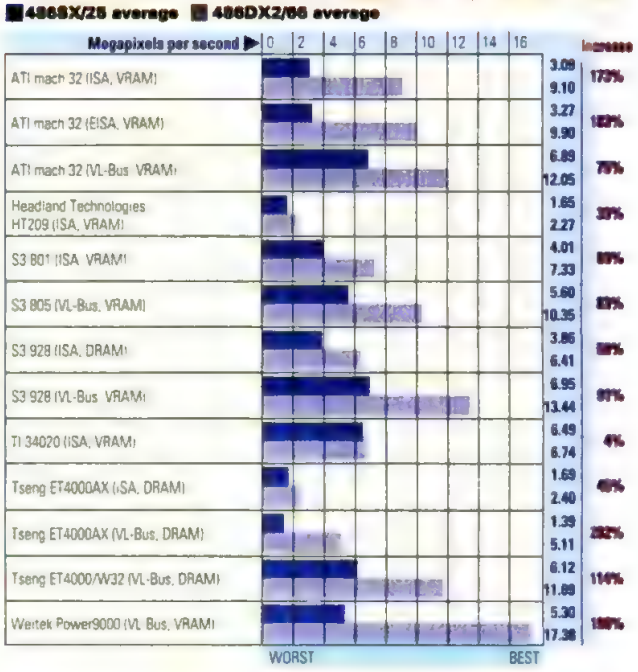


N/A— Not applicable: The board does not support this resolution and color depth.

Video Card Performance by Bus Type

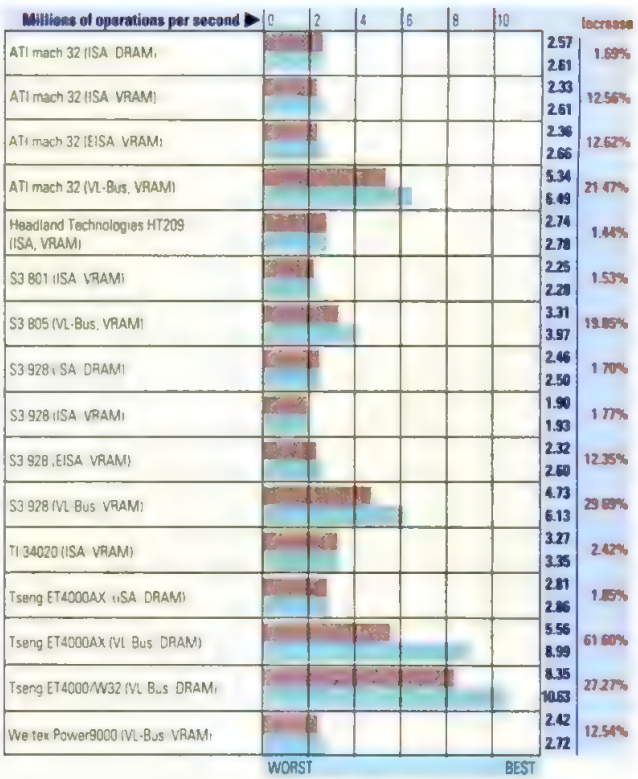


The Effect of a CPU Upgrade (Windows)



VIDEO

The Effect of a CPU Upgrade (DOS)



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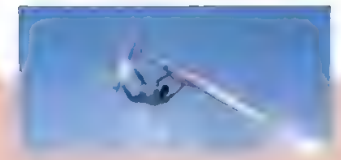

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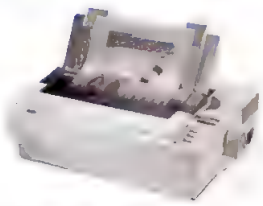

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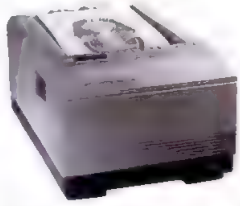

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Sources for Up-to-Date Windows 3.1 Drivers

CONTINUES

Although video boards typically ship with the latest version of the drivers for Microsoft Windows 3.1, the drivers are updated throughout the life of each board. To obtain the latest drivers, customers can either download the drivers from a bulletin board or call vendors' technical support numbers and ask for disks. Some video board manufacturers update their drivers as frequently as once a month. Most vendors, however, release new drivers every 6 to 12 months. Users should check for driver updates at regular intervals. Here are technical support numbers and on-line addresses for information on 128 video boards that were introduced by major vendors since the beginning of 1992.

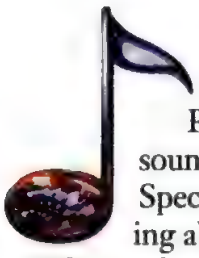
Company	Graphics board series	Technical support number	Bulletin board number	CIS location
Aamazing Technologies Corp.	Aamazing VGA 880, Aamazing VGA 1000, Aamazing VGA 1080, Aamazing VGA 1280	714-255-1688	None	None
Actix Systems Inc.	Actix GraphicsEngine, Actix GraphicsEngine MCA, Actix GraphicsEngine 32 Plus	408-986-1625	408-970-3719	None
Advanced Integration Research Inc.	Optima, STAR2000	408-428-0800	408-428-1735	None
Advanced Micro Technology	Sigma-24, Sigma-32	909-598-6120	909-594-5770	None
AITech International	ProColor Plus, Pro VGA/TV Plus, VideoSurge, WaveWatcher, WaveWatcher TV	800-882-8184	408-946-2227	None
Alpha Systems Lab Inc.	Lightning SVGA	800-576-4275	None	None
Artist Graphics Co.	WinSprint 900, WinSprint 1000i	800-627-8478	612-631-7664	None
ATI Technologies Inc.	Graphics Ultra, Graphics Ultra Plus, Graphics Ultra Pro, Graphics Vantage, 8514-Ultra	416-756-0711	416-756-4591	GO ATITECH
Atlaz International Ltd.	Cirrus Logic, Trident 89CL, Trident 9000, VESA	516-239-1854	None	None
Boca Research Inc.	SVGA25, SVGAX2, SVGAX3, SXVGA1, SXVGA5	407-241-1606	407-241-8088	GO BOCA
Cache Computers Inc.	Lynx VGA Model 336	510-226-9922	510-226-7486	#71053,416 (inquiries only)
Cardinal Technologies Inc.	VideoSpectrum, VideoSpectrumXL, WarpSpeed	717-293-3124	717-293-3074	None
Celerite Graphics Inc.	Galaxy 2000	510-226-6390	510-226-7851	None
Colorgraphic Communications Corp.	Super MVGA, Twin Turbo Accelerator	404-455-3921	404-452-8238	None
Compaq Computer Corp.	QVision	800-345-1518	713-378-1418	GO CPQFOR
Cornerstone Technology Inc.	ImageAccel 1280, ImageAccel 1600	800-562-2552, ext. 306	408-435-8943	None
CSS Laboratories Inc.	MaxGraphics/32	800-966-2771	714-852-9231	None
Diamond Computer Systems Inc.	SpeedStar Pro, Stealth Pro (ISA or VLB), Stealth 24 (ISA or VLB), Viper VLB	408-736-2000	408-773-1100 (up to 2,400 bps), 408-524-9301 (above 2,400 bps)	Graphics Vendor B Forum
Edge Technology Inc.	Edge D24 BitBlaster Plus, Edge VL24 BitBlaster	800-438-3343	Pending	None
ELSA America Inc.	ELSA Gemini 200, ELSA Winner 1280	800-272-3572	415-588-6286	Forum pending

The Perfect Display

ENDS

Company	Graphics board series	Technical support number	Bulletin board number	CIS location
Focus Information Systems Inc.	2 the Max Cheetah, 2 the Max Cheetah XL, 2 the Max TrueSpeed	510-657-4586	510-657-9451	None
Genoa Systems Corp.	Multimedia VGA, Windows VGA, Windows VGA 24, Windows VGA 24 +	408-432-8324	408-943-1231	#76124,532 (inquiries only; drivers pending)
Hercules Computer Technology Inc.	Hercules Chrome, Hercules Graphite Card, Hercules SuperStation XP	510-623-6050	510-623-7034 (V.32); 510-623-7142, 510-623-7449 (V.32bis)	GO HERCULES
Identity Systems Technology	IDSVGA16-5, IDWINXL-A3	800-723-8324	214-705-7213	None
IOcomm International Technology Corp.	HC, TC Michaelangelo VRAM, Michaelangelo VRAM Pro,	800-998-8919	None	None
Liberty Electronics USA Inc.	VGS-20, VGS-30	800-497-8324	None	None
Matrox Electronic Systems Ltd.	MGA Impression, MGA Ultima	800-462-8769	514-685-6008	None
Metheus Corp.	Premier 801, Premier 928-1M, Premier 928-2M, Premier 928-4M, Premier 928-VL2, Premier 928-VL4	503-690-1550	503-690-1559	None
MicroStep Inc.	MicroStep AGC-2075e, MicroStep AGC-2075 Plus	818-336-8991	818-961-9992	None
Mirage Computer Systems	Mirage 2, Mirage 2-4000 VL, Mirage 2-4000 W32 VL, Mirage Storm 1280-16, Mirage Storm 1280-256	310-440-1460	Pending	None
National Design Inc.	AT2000, Volante Warp10LB, Volante Warp10Plus	512-329-5055	512-329-6327	None
Nth Graphics	Nth Edge 1280, Nth S3 Advantage	800-624-7552	512-832-1964	None
Orchid Technology Inc.	Fahrenheit 1280, Fahrenheit 1280 Plus, Fahrenheit VA, ProDesigner IIs	510-683-0323	510-683-0327	None
Sigma Designs	Sigma Legend GX, Sigma Legend 24LX, Sigma WinStorm	510-770-0100	510-770-0111	GO DTPVEN
SixGraph Computing Ltd.	Wizard 924, Wizard 9000VL	800-561-2892	514-336-4169	None
STB Systems Inc.	A1-VGA, Evolution, Horizon VGA, Horizon VL, Mach 512, Pegasus VL24+, PowerGraph VL-24, PowerGraph X-24, Wind/X Pro	214-234-8750	214-437-9615	GO STBSYS
SuperMac Technology Inc.	Thunder/24 for Windows	408-245-0646	408-773-4500	GO SUPERMAC
Swan Technologies Inc.	Swan VeLocity Card	800-468-7926	814-237-6143	GO SWAN
VideoLogic Inc.	Rapier 8-24, Rapier 24	617-494-0530	617-494-4960	GO VIDEOLOGIC
Video Seven	Win.PRO, Win.Swift, Win.VGA	800-248-1850	510-656-0503	None
VidTech Microsystems Inc.	FastMax, FastMax LB, GraphMax, GraphMax LB	800-752-8033	612-780-3564	None
Western Digital Corp.	SVGA1MB, SVGA512, VLBUS3156, XLR831, XLR83160	800-832-4778	714-753-1234 (1,200/2,400 bps), 714-753-1068 (9,600 bps)	None
Wyse Technology Inc.	WY-451, WY-470	800-800-9973	408-922-4400	None

SOUND.



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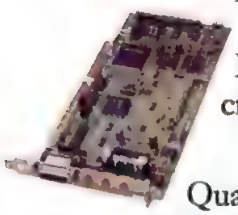

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ADVICE.

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T. Carlton, *PC Games*, Mar. '93

"For my money, the PAS16 is the best deal going."
R. Lauriston,
PC World, Nov. '92

"The PAS 16 is currently the best deal available in a 16-bit card."
D. English, *Compute*, Jan. '93

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Wall Street Journal, Oct. '92

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J. Quain, *PC Magazine*,
Sept. '92

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One in a series of observations on health in the workplace:

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In the early 1980s, Dr. James Sheedy, founder of the VDT Clinic at the University of California at Berkeley, noted that most of his patients complained of eyestrain, double vision, nearsightedness, and other vision problems directly related to their use of video display terminals.

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number of horizontal and vertical pixels it can display. The most commonly used resolutions are 640-by-480 (VGA), 800-by-600, and 1,024-by-768. Monitor makers continue to push the pixel envelope, and an increasing number of displays support 1,280-by-1,024 resolution (1.3 million pixels per screen). But putting more information on the screen affects a monitor's construction and performance. Constraints are defined by horizontal and vertical scan rates and bandwidth, which are measured in Hz, kHz, and MHz.

Putting more information on the screen affects a monitor's construction and performance.

CRTs create images by guiding an electron beam across the inside surface of a glass tube lined with chemical phosphors. The phosphors glow when hit by the electrons. By turning the beam on and off rapidly, the CRT creates patterns of illuminated and dark spots along the path of the beam. The electron gun begins at the upper-left corner of the monitor and scans across a horizontal line. At the end of the line, the beam is turned off and aimed at the beginning of the next line. Scanning continues line by line down the length of the monitor. After the last line, the beam returns to the upper-left corner and begins again.

The *vertical scan rate*—or *vertical refresh rate*—describes how many times per second the beam begins from the upper-left corner. If the refresh rate is too slow, the glow of the phosphors will fade before the beam lights them up again on the next pass. This creates a flashing effect, or *flicker*.

One way to reduce flicker is to use phosphors with a slower decay rate. The original PC and XT monochrome monitors used this approach, and although it worked well for text displays on slow computers, the results are not very good for high-speed graphics displays. Because the phosphors lose their glow more slowly, ghosts or streaks appear on the screen. Monitor specifications generally list phosphor type as *medium-short* or *short*.

Another way to reduce flicker is to increase the vertical scan rate; repainting the image more times per second leaves less time for the phosphors' glow to decay. When higher-resolution video cards first appeared, there were no scan rate standards. Many cards with 800-by-600 resolution managed only a 56-Hz vertical scan rate, which yielded a noticeable flicker. VESA, which was formed to bring standardization to the market, provides refresh rate guidelines for various resolutions (for more information, see "VESA Monitor Timing Standards").

The refresh rate is determined by the signal produced by the video card, but your monitor must be able to handle the signal correctly. Most monitor specification sheets show a range of supported frequencies, which makes matching monitors with video cards difficult. A monitor that supports a 72-Hz vertical refresh rate might not do so at all resolutions.

Vertical refresh comes in two flavors: interlaced and noninterlaced. Interlaced scanning covers a complete screen in two passes (by scanning every other line), while noninterlaced scanning covers the entire screen in a single pass. Most users find that interlaced displays produce an inordinate amount of flicker, and in general you should seek noninterlaced displays. Interlacing is commonly used in less expensive monitors at 1,024-by-768 resolution. Also, be sure to watch out for interlaced monitors that claim a maximum 86- to 90-Hz refresh rate. With only one-half the scanning occurring 86 to 90 times per second, the complete screen is repainted only about 45 times per second.

The horizontal scan rate can be roughly calculated by multiplying the number of lines per screen by the number of vertical scans per second (resolution × vertical refresh rate). Thus, a 640-by-480 screen with a 60-Hz refresh would require 28,800 scans per second. You also need to factor in the time lost in bringing the beam back to the start of the line, and from the bottom to the top of the screen. Factor in about a 10 percent penalty for

SOUND

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Nikon
ELECTRONIC IMAGING

Recommended Dot Pitch for Each Resolution

Monitor size (diagonal, in inches)	Image width (mm)	Resolution (horizontal x vertical)			
		640 x 480	800 x 600	1,024 x 768	1,280 x 1,024
		Dot pitch (mm)			
14	265	0.35	0.28	0.22	0.18
15	284	0.38	0.30	0.24	0.19
17	322	0.43	0.34	0.27	0.22
20	379	0.50	0.40	0.31	0.25

(Image width/horizontal resolution) x 0.85 = maximum recommended dot pitch

these factors and you get 31,700 horizontal scans per second, or 31.7 kHz.

At 800-by-600 resolution with a 72-Hz vertical refresh, you need a monitor capable of providing a 47.5-kHz horizontal scan rate. And at 1,024-by-768 resolution with a 70-Hz vertical refresh, you need roughly a 59-kHz horizontal refresh rate.

Another factor that must be considered is *bandwidth*, which generally is not reported. Bandwidth is a measure of how fast the electron beam can be turned on and off. If the electronics of a monitor cannot turn the electron beam on and off rapidly and accurately enough, the pixels will be blurred. Bandwidth requirements can be estimated by multiplying 1.5 by the total number of pixels by the vertical refresh rate.

For a VGA screen at 640-by-480 resolution with a 60-Hz refresh rate requires a bandwidth of 27.6 MHz (millions of cycles per second) to create a screen accurately. For 800-by-600 resolution at 72-Hz, the bandwidth requirement is 51.8 MHz, and for 1,024-by-768 at 70 Hz, the bandwidth jumps to 97 MHz. A monitor that can handle a bandwidth higher than the image's requirement will look significantly better.

Curved screens are more susceptible to glare than flat screens are, but curved screens are easier to engineer.

DOT PITCH AND SCREEN SIZE

Dot pitch and viewable screen size must also be considered in selecting a monitor. The spacing between the triads of red, green, and blue phosphors in a color monitor is known as *dot pitch*, and is typically measured in hundredths of a millimeter. Higher resolution means the pixels will be smaller on the monitor. To create a white dot on a color screen, the electron beams need to hit at least one phosphor dot of each color: red, green, and blue.

A typical 14-inch-diagonal monitor has a viewable screen area that is about 265 mm wide. VGA resolution requires 640 dots per line. If the monitor's beams hit only one phosphor triad per pixel, a dot pitch of 0.41 mm is required. For an 800-by-600 SVGA image on the same screen, a 0.33-mm dot pitch is needed. And at 1,024-by-768 resolution, a 0.26-mm dot pitch would be required.

If the dot spacing were larger than these measurements, the monitor could not create a single "white" pixel. Even these measurements yield a noticeably coarse image. To calculate a workable figure for a minimum dot pitch, see "Recommended Dot Pitch for Each Resolution."

The type of tube that is used in the display can also have an affect on image quality. Curved screens are more susceptible to glare than flat screens are, but they are easier to engineer (to make the electron beam more accurate). The only truly flat screens are made by Zenith Electronics Corp. Sony Trinitron tubes, which are used in many top-of-the-line monitors, are flat only in the vertical plane and curved in the horizontal plane. Other tubes have surfaces that are basi-

SOUND JUDGMENT.

PC MAGAZINE EDITORS' CHOICE

April 27, 1993

Pro AudioSpectrum 16

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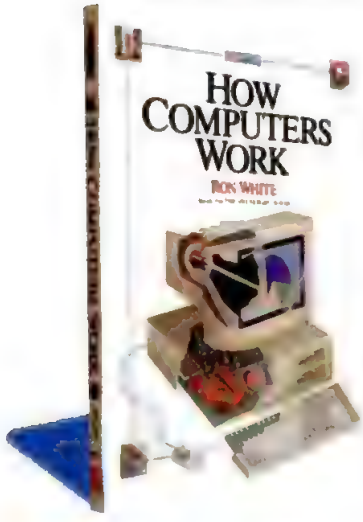

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cally a section of a sphere, although the newer flat-square designs are much flatter than older monitors.

HOW BIG A SCREEN?

All this leads to the question of how much monitor you should buy. A 17-inch monitor makes an affordable step up from a typical 14-inch desktop screen, but for the really big picture, go for a 20-inch model. Remember that most monitors are as deep as their diagonal display measurements, so make sure you have enough room on your desk to hold the monitor you buy.

A larger monitor enables you to put more data on the screen. For a word processor, this can mean showing more of a page or showing two full pages side by side. For a spreadsheet, it can mean showing more cells at one time. For Windows applications, it can mean having more than one application window open and visible at once.

Although you gain more information on your screen when you increase a monitor's resolution (because there are more pixels), Windows characters and icons shrink (for more information, see the "Stretching the Screen: Monitor Size and Resolution"). Once you have determined the screen size, resolution, and refresh rates, you can look at monitor controls and features to narrow your selection. Of course, the size of your budget will also play a large role in your choice. The best monitors have digital controls that can store the image size and placement settings for many different image signals. At the very least, you will want controls for image size and placement in both vertical and horizontal directions.

You may also want to consider the electromagnetic emissions produced by the monitor. This topic has received a great deal of coverage in recent years, but the issues remain unresolved. At present, there is no widely held agreement on what health risk these emissions pose, if any, and what a "safe" level of exposure might be. The leading standards for emissions have been established by the Swedish National Board for Measurement and Testing (MPR). The initial MPR standard defined limits for VLF (very low frequency) emissions, and the newer,

more stringent MRP II standard also limits its ELF (extremely low frequency) emissions. Not all monitor manufacturers tout the fact that their monitors conform to one or both of these standards. If you decide that you want a low-emissions monitor, don't reject one simply because the advertisements don't mention MRP compliance.

THE FOUR PERFECT PCs

So which monitor should you choose for your perfect PC? We have reviewed a host of monitors over the last year, and our Editors' Choice winners are listed in an accompanying box.

If you have an unbridled budget and are building a personal dream machine, purchase a large, high-quality, high-resolution monitor (one that is matched in ability by the video adapter you choose). A good choice would be a 20- or 21-inch top-brand monitor with a 0.25-mm dot pitch at most, running at 1,280-by-1,024 resolution.

For the basic business Windows workstation, a 17-inch monitor running at 800-by-600 or at 1,024-by-768 resolution can provide an edge in information handling and comfort over 14- and 15-inch models. Image quality will be better than with VGA resolution, and reasonably priced models are available.

If you are looking for the perfect SOHO machine, the choice largely depends on whether you intend to run Windows. If you do, we recommend that you buy at least a 14-inch screen with 800-by-600 resolution. If your budget will allow, you should get a 15-inch model. If you are working with text only, you should consider a monochrome display, which can save you a significant amount of money. If you are running only DOS applications that do not support resolutions higher than VGA (or you do not intend to use the higher-resolution modes), buy a 14-inch VGA monitor with a 0.30- to 0.35-mm dot pitch.

For a file server, your best bet is a simple monochrome monitor, which will save you enough money to buy a large hard disk. Although there are some server applications that can take advantage of higher-end displays, you might do better spending the money on other components. □

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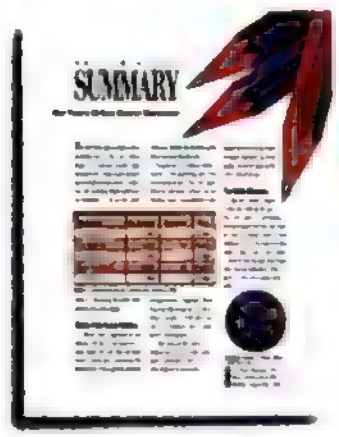

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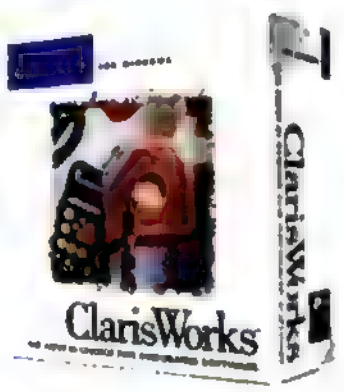

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CIRCLE 178 ON READER SERVICE CARD

The PERFECT HARD DISK

CHOOSING THE PERFECT HARD DISK FOR YOUR SYSTEM DEPENDS ON HOW MUCH ROOM YOU NEED AND HOW YOU'RE GOING TO USE IT.

BY JOHN R. QUAIN

If CPUs are the hearts of PCs, then hard disk subsystems are their legs. Your applications can call up spreadsheets and documents only as fast as your hard disk can retrieve them. Small, slow drives won't carry your PC very far.

For most of us, making a hard disk buying decision is not hard: Budget PC and Windows business users need look no farther than a fast 200MB to 350MB IDE (integrated drive electronics) drive and a software caching program. When it comes to everyday computing tasks, this combination on an ISA (Industry Standard Architecture) PC works as well as any other—and sometimes better. IDE drives are today's best price/performance bargain.

Power users and network managers—for whom top performance means everything—need more storage and flexibility. For them, today's gigabyte-size SCSI-2 drives riding the EISA (Extended Industry Standard Architecture) bus present the best solution. But if you fall into one of these two groups, you'll have to pick your way through a thicket of thorny controller and caching issues to find the perfect hard disk.

A typical 340MB IDE kit (with the host adapter and cables) will set you back $500 to $700. The same drive in a SCSI (small computer system interface) configuration will cost another $130. But as you move up the storage-capacity ladder, the percentage difference in price shrinks: A 1GB IDE kit costs $1,100 to $1,700, while a comparable SCSI drive still costs only about $130 more. Basically, if you need only 200MB capacity, you only need an IDE drive. But if you need infinite storage space, SCSI drives make more sense.

What you're paying for is simple, mechanically. A motor spins one or more rigid, nickel-covered aluminum platters on a spindle at 3,400 to 5,400 revolutions per minute (rpm). (Expect drives that spin at rates of up to 7,200 rpm by the end of the year.) A tiny arm, or actuator, swings out over each side of the platter, suspending a read/write head 10 microns or less above the magnetic layer of the disk. The spinning platter creates a slight airfoil lift effect on the actuator, which prevents the heads from making contact

The Ultimate Hard Disk

HIGHLIGHTS

The Perfect Hard Disk

THE BEST HARD DISK solution for budget PC and Windows business users is a 200MB to 350MB IDE drive and a software caching program. IDE drives offer up to 4MB-per-second throughput and come in capacities that range from 40MB to 1GB.

POWER USERS and network administrators will want to investigate SCSI drives; chainable SCSI drives can hold up to 3GB each, and throughput rates for Fast-Wide SCSI-2 drives extend to 40MB per second. SCSI drives typically cost about $130 more than comparable-capacity IDE drives.

WITH IDE DRIVES, the VL-Bus configuration was the clear overall winner in terms of performance. During testing, we found that an unassisted SCSI-2 drive performed about the same on the ISA, EISA, and VL-Bus expansion buses.

A HARDWARE CACHE BOOSTS drive performance by reading ahead outgoing—or storing incoming—data requests and holding them in memory until the drive is free. A software cache stores information in extended memory. With a hardware cache, the information that is being cached still needs to cross the I/O bus; software caching, on the other hand, can pass the information directly to the CPU using the local memory bus but is limited by the amount of available system memory.

ADDING A SOFTWARE CACHE to an IDE drive results in almost the same performance gain as does adding a hardware cache—but at a fraction of the cost. Mixing software and hardware caches on IDE drives yields mixed results, but on SCSI drives, adding both types of caches provides the best performance.

with the disk. As the heads fly above the platter, reads and writes are performed by making magnetic changes on the disk.

Finding a fast hard disk, though, means more than finding the fastest drive mechanism. Hard disk controllers, hardware and software caching techniques, and expansion buses play important, interdependent roles in determining disk-subsystem performance.

PUT ON AN INTERFACE

Effectively, there are only two choices for a hard disk controller type today: IDE or SCSI. Previously, ESDI (enhanced small device interface) competed as a third option, but the ESDI interface proved unable to match the performance of SCSI drives or the value of IDE models. Thus, ESDI drives are all but extinct, with several major hard disk manufacturers no longer offering ESDI drives. Compared with the hundreds of IDE and SCSI models available, only a small number of ESDI drives remains on the market.

Today, the most popular hard disks for single-user PCs are IDE drives. Also known as AT drives, these models have most of their control circuitry built onto the drive. In many ways, this makes them simpler and less expensive. State-of-the-art IDE drives offer data transfer rates ranging from just over 1MB per second to more than 4MB per second, moving enough data to keep an ISA bus busy. IDE drive capacities range from 40MB to 1GB, and a standard IDE host adapter can usually handle two IDE drives—plenty of storage for most users.

If you need, however, more storage and more devices—without sacrificing performance—try a SCSI drive. You can daisy-chain up to seven SCSI devices (like hard disks and CD-ROM players) on one adapter, and a single SCSI drive can hold up to 3GB.

In addition, SCSI drives are smarter than your average IDE drive. While IDE drives need to wait for the CPU to read and write to the disk, for example, SCSI models are able to operate asynchronously, saving computing time and allowing bus-mastering and burst modes. Command queuing lets a SCSI drive reorder data requests to optimize performance. Instead of searching back and forth over the disk to fill requests, command queuing reorganizes the requests so that the drive retrieves the file closest to the current head position first and then gradually moves out to those files farther away.

A major drawback of SCSI drives can be the Cirque du Soleil–like maneuvers users must endure to get more than two SCSI devices to work together on one PC. The draft SCSI-2 standard, which should be ratified soon after you read this, marks an attempt to improve compatibility and performance. Today, most SCSI drives are draft SCSI-2 compatible.

The main advantage of draft SCSI-2 is that it tightens the requirements for SCSI-compatible peripherals. It also adds new command extensions that leave the door open to more specific support for new devices in the future. SCSI-2, however, requires different hardware and command-set support than the original SCSI to get full benefits.

To increase data transfer, for example, SCSI-2 includes protocols such as Fast SCSI, which is twice as fast as the original 5MB-per-second synchronous data transfer rate specification. Fast SCSI offers a maximum transfer rate of up to 10MB per second over an 8- or 16-bit data path. Wide SCSI extends the SCSI data path to either 16 or 32 bits and allows throughput of 20MB per second over a 16- or 32-bit path. Fast-Wide SCSI provides 20MB-per-second transfer over a 16-bit path, or a 40MBps asynchronous transfer rate over a 32-bit path. (For more information on SCSI technology, see "Fast and Flexible: SCSI Technology Grows Up" in our June 29, 1993, issue.)

Does that mean you just choose between an IDE or a SCSI-2 drive, and your worries are over? Not quite. A Gordian knot of issues is tied to hard disk performance, beginning with the expansion bus.

Our Contributors: JOHN R. QUAIN is a contributing editor to *PC Magazine.* JENNIFER ZAINO was the associate editor in charge of this story, and MICHAEL J. ZULICH was the project leader.

CD-ROM: *Gaining Momentum*

by John R. Quain

CD-ROM drives are gaining in popularity nearly as quickly as audio CDs supplanted vinyl records a few years back. The disadvantages of CD-ROM players (they are read-only and are 20 times slower than hard disks) are far outweighed by their benefits. Players cost as little as $280, and a single 4.72-inch disk stores as much as 680MB of data. And the CD-ROM software market is finally beginning to mature, offering everything from home medical reference works to entire encyclopedias on a single disk.

If you plan to build a library of CD-ROM disks, check your hard disk space. Installing a single CD-ROM title can take up to 8MB of space for graphics and search files. If you have an IDE drive, make sure you have an extra expansion slot. Most CD-ROM drives require a SCSI host adapter.

According to the MPC (Multimedia PC) Marketing Council, a multimedia-compatible CD-ROM player must have a minimum sustained data transfer rate of 150K per second, have an average seek time of one second or less, and require no more than 40 percent CPU utilization.

Today, most CD-ROM players claim to be up to the MPC throughput specification. Standard single-speed CD-ROM drives typically have average access ratings of 350 ms (which compares with hard disks' less-than-20-ms access times) and can maintain a 150K-per-second average data transfer rate. *Double-speed drives*, pioneered by NEC Technologies more than a year ago, offer average access times of 280 ms or faster and throughput of 300K per second or better. To achieve this, double-speed players spin and decode disks containing text, graphics, and video at twice the standard rate.

But a double-speed drive will cost you twice as much as a standard single-speed drive. Current double-speed models include the NEC MultiSpin 84 Internal CD-ROM Reader (about $550; 708-860-9500); Toshiba America Information Systems, Disk Products Division's TXM-3401E ($895, and about $600 on the direct market; 714-583-3111); and Sony Computer Peripheral Products Co.'s CDU-561 ($648; 800-352-7669).

The CD-ROM software market offers everything from medical reference works to entire encyclopedias.

Despite the baffling array of CD-ROM formats, there are only two you need to pay attention to for a PC-compatible CD-ROM drive. The first is *CD-ROM XA* (Extended Architecture). Originally intended as a standardized way to play back CD-ROM video clips synchronized with compressed audio, XA has fallen into disuse of late. To play back an XA disk, the information read by the drive needs to be decoded differently. Until recently, few XA-compatible players existed, and so few software developers spent the money to develop titles for the format. But that may change. NEC's and Toshiba's double-speed drives, for example, are now fully XA compatible. As more of these drives enter the market, more software developers may adopt XA.

The other format is Eastman Kodak Co.'s *Photo CD*. Until recently, only single-session recordings made under the Photo CD format could be read by Photo CD–compatible CD-ROM players. Now, Photo CD Access software ($39.95; 800-242-2424, ext. 52) lets you display photos under DOS even if they were recorded in several different sessions. Several CD-ROM players are now compatible with multisession Photo CD, including the double-speed NEC and Toshiba drives.

Suppose the idea of CD-ROM appeals to you, but you also want to be able to write to the disks. For recording ISO 9660 standard CD-ROM disks, there are a few suitable CD recorders, including Philips Consumer Electronics Co.'s CDD521 Compact Disc Recorder system ($7,995 to $8,995; 800-835-3506) and Kodak's PCD LAN writer 200 ($13,995). If these prices are too exorbitant and you don't need to publish CD-ROM titles, investigate magneto-optical (MO) drives. Using cartridges containing prestamped optical disks, MO drives offer removable storage that is faster than tape drives and, in some cases, nearly as fast as today's hard disks.

Pinnacle Micro's PMO-650 5.25-inch external MO drive ($3,195; 714-727-3300), for example, can store up to 595MB per $160 cartridge (298MB per side). Using XCOPY to transfer 123MB from an ESDI (enhanced small device interface) drive to the PMO-650 takes a mere 10 minutes and 58 seconds. Copying the same data from one hard disk partition to the other on the same ESDI drive takes nearly as long.

To attain the improved performance, the Pinnacle drive boosts the disk rotation from the standard 2,400 rpm to 3,600 rpm and employs *split optics*. Split optics reduces the mass of the head by putting most of the heavy laser optics onto a fixed part of the drive.

Pinnacle was the first to use split optics in a 5.25-inch drive. Now Fujitsu Computer Products of America has introduced a 3,600 rpm, 3.5-inch MO drive ($1,300; 408-432-6333) that uses split optics. The 3.5-inch MO drive kit has a 38.3-ms average access time and can store 128MB on a 3.5-inch disk. □

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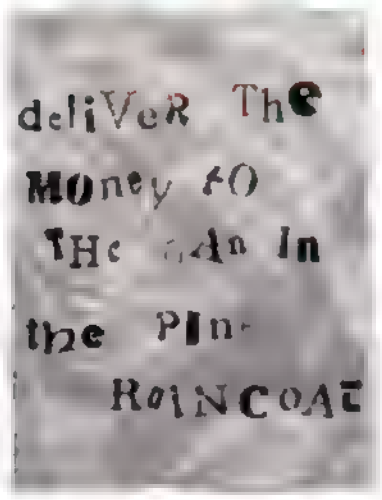

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EISA, ISA, AND VESA

A 16-bit wide 8-MHz ISA expansion bus has a theoretical throughput limit of 8MB per second. In practice, the limit is more like 1.5MB per second. This was plenty for earlier hard disks, but even today's swifter IDE models can deliver more data than the ISA bus can carry. And 32-bit EISA expansion buses with double the data-throughput capacity will still keep a fast SCSI drive waiting.

Enter the youngest combatant in the expansion-bus wars: the VESA (Video Electronics Standards Association) VL-Bus. With its additional connectors, the VL-Bus provides access to a 486 system's local 32-bit full clock-speed bus.

On the surface, this looks like an attractive way to increase data throughput to and from the hard disk. And, indeed, IDE drives properly configured with an appropriate host adapter reap significant benefits for a mere $30 to $40 more than a standard ISA IDE drive kit. But not all hard disks derive the same benefit, and several SCSI-2 controller manufacturers are passing by the VL-Bus in favor of more mature EISA systems.

CACHING IN ON CONTROLLERS

No matter what bus you're on, you can always try to get a better seat. That's the reasoning behind adding memory to disk controller cards. Referred to as hardware caches, these high-end adapters can cost as much or more than the hard disk itself. Hardware caches work with the drive to read ahead outgoing—or store incoming—data requests and hold them in memory until the drive is free.

For individual users, the drawback of most hardware caching controllers is that the cached information still has to cross the I/O bus. Software caches, which store the information in extended memory, have the advantage of being able to pass the information directly to the CPU via the local memory bus. So no matter what expansion bus standard your PC conforms to, a software cache will help.

SOFTWARE SAVES CACHE

Software caches enhance hard disk performance by intercepting disk read and writes in system memory. In the former case, the caching algorithm anticipates what file will be requested next and reads ahead so that the information can be stored in memory. During writes, the cache stores the requests in memory until it's full or until the cache detects a spare (or empty) clock cycle. When that happens, the program hands the information off to the drive's device driver, which then writes it to disk.

The only catch with software caching is that you're limited by the amount of system memory. Suppose you like to keep a half dozen or more Windows applications active at any given time. Enabling a software disk cache can cramp your style if you only have, say, 4MB or 8MB of system RAM.

BENCHMARK TEST RESULTS

In order to examine the performance differences among different expansion buses, disk controllers, and disk caches, PC Magazine Labs tested 36 different hard disk subsystem configurations. Using AMI motherboards—each with a 33-MHz 486DX CPU, a 256K system cache, and 8MB of RAM—the test machines were loaded with DOS, Version 5.0, and tested using PC Labs' Hardware Benchmark Tests, Release 7.01, DOS Disk test.

To compare IDE, SCSI, and SCSI-2 drives, we tested three 3.5-inch 500MB hard disks from Seagate Technology (408-438-6550): an ST3600A IDE (540MB, formatted), an ST3550N Fast SCSI-2 (457MB, formatted), and an ST3600N Fast SCSI-2 (525MB, formatted). The ST3550N and the ST3600N were tested as both SCSI-1 and SCSI-2 devices. Each of the drives uses the same 4,500-rpm four-platter mechanism, with a 17.1-millisecond rated average access time (10.5-ms average seek and 6.6-ms latency) and a 256K multisegmented adaptive cache on-board.

To test the IDE drives, we used an AMI ISA noncaching adapter and two adapters from Promise Technology (408-452-0948): a SuperIDE DC-200 with 2MB of RAM (under $200 through dealers), and an IDE DC-4030VL VL-Bus adapter with 2MB of RAM (less than $300 through dealers). For SCSI-1 testing, we used an Alpha Research Corp. ISA S425S ($449; 512-836-0709); a Distributed Processing Technology (DPT) ISA SmartCache Plus SK2011/95 ($595; 407-830-5522), and an EISA DPT Smart-

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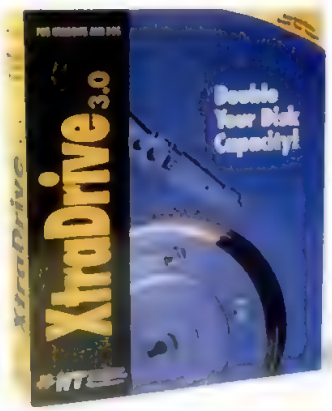

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CIRCLE 236 ON READER SERVICE CARD

Cache Plus SK2012B/95 ($695). For the SCSI-2 tests, we used an EISA AMI Series 48 and a VL-Bus BT-445S from BusLogic ($449; 408-492-9090). All hardware caching was set at 2MB.

We also tested software caching programs in each of the various configurations. Tests included PC-Kwik's Super PC-Kwik, Version 5.01 ($79.95, and about $35 direct; 503-644-5644); HyperWare's HyperDisk SpeedKit, Version 4.50, shareware ($49.95; 415-882-1740); and Microsoft Corp.'s SmartDrive, Version 4.0; which is included free with Windows, Version 3.1 (800-426-9400). On our tests, each software cache was configured for 2MB. As you might expect, a hardware cache does improve disk performance. On the ISA bus, an IDE drive outfitted with a 2MB hardware cache performs three times faster on our tests than the same drive without the hardware assist. In the same situation, however, a 2MB software disk cache will do nearly as well, delivering up to two and a half times the performance of the unassisted drive. With software caching utility prices as low as $35 (which compares with $200 for an equivalent hardware-cached IDE adapter), a software cache is the runaway price/performance leader.

Combining hardware and software caches yields mixed performance results, depending on how well a given combination works together. We found that Super PC-Kwik tended to improve the performance of an IDE adapter's hardware cache by a couple of percentage points, while SmartDrive often hampered hardware caching. IDE users are thus advised to go with only one type of cache.

During testing, IDE drives benefited

▪ Storage Necessities: *Floppy Disk Drives*

by John R. Quain

No storage device is more basic to your PC than a floppy disk drive. You can forego a CD-ROM player, ignore a tape backup drive, even skimp on a hard disk. But a floppy disk drive is a necessity.

Nearly all floppy disk drives today are high-density drives of either the 1.44MB, 3.5-inch or the 1.2MB, 5.25-inch variety. Both of these drives are backwards compatible with lower-density disks, and you should consider getting one of each. You will need the larger, 1.2MB drive to ensure compatibility with older machines, on which 5.25-inch drives continue to predominate. And the move to 3.5-inch drives, especially on notebook PCs, means you'll need the smaller, 1.44MB drive as well.

SPACE-SAVING DESIGN

The perfect PC also should save space wherever possible. So consider saving a drive bay in your machine by choosing a *dual-media,* or dual floppy disk drive. These combination units stuff a 3.5-inch and 5.25-inch drive into a single half-height drive bay. Canon USA's MD-5511-V6 (214-830-9600) and Teac America's FD505 Combo Drive (213-726-0303) are two such combination drives. Prices for dual floppy disk drives are only about 10 percent more than what it costs to buy individual floppy drives, and the dual floppy disk drives take up only one adapter connection, saving the other adapter connection for, say, a tape backup device.The one problem with floppy disk drives is that they can thwart your office's sneaker net if you have to transfer graphics files that are larger than 1.44MB (or other kinds of space-hogging files). Though there are a few 2.88MB, 3.5-inch floppy disk drives on the market (most notably the offerings from IBM), these units still don't give you enough room for today's 4MB, 24-bit color graphic files, for example.

Since the perfect PC should also save space, you might want to consider a dual floppy disk drive.

The best option for handling this type of large file is the 21MB Floptical drive. Brier Technology offered some of the first 21.4MB floppy disk drives over two years ago. These drives are not backward compatible with standard 3.5-inch floppy drives, however.

About two years ago, Insite Peripherals Corp. introduced a competing Floptical technology that is backward compatible. Drives based on Insite's I325VM 3.5-inch Floptical drive mechanism can store 20.88MB of data on a single disk. They can also read or write to standard 1.44MB, 3.5-inch and 720K, 3.5-inch floppy disks. Externally, the 21MB disks look identical to the 1.44MB, 3.5-inch disks but cost more; each can set you back about $12.

To get the additional data onto the 3.5-inch disks, Insite-based drives use two heads. The disks have optical servo positioning tracks, as well as standard magnetic recording tracks. An optical head uses the optical tracks in order to position the magnetic read/write head precisely; this way, more tracks can be squeezed onto a disk.

A consequence of this higher bit density and 720-rpm rotational speed is that 21MB Flopticals were three times faster than 1.44MB floppy disks on PC Magazine Labs' DOS disk access tests. Rated average access time for a typical Floptical drive was 122 ms. This compared with 240 ms for a standard 1.44MB drive.

Several manufacturers, including GrassRoots and Iomega Corp., are currently selling Insite-based drives. But these drives still cost about six times as much as a standard floppy disk drive. Floptical prices on the direct market are priced at about $350 for an internal drive.

About the only caveat to consider regarding this particular matter is that some Floptical drives will require a proprietary host adapter, which means you will have to relinquish an expansion slot. □

Hard Disks: Vendor Offerings

When equipping your perfect PC, it's helpful to know which hard disk manufacturers offer the perfect hard disk for your needs. Below, you'll find information on a range of hard disk options; we list their types, capacities, and sizes. Here we include only IDE and SCSI offerings in the 200MB-or-better class. For information on smaller-capacity hard disks or, say, ESDI (enhanced small device interface) hard disks, consult the table in its entirety online. The table is available on ZiffNet in PC Magazine's Editorial Forum. To download the table, type GO ZNT-EDITOR; select Library 2, Features Hardware; and download HDDISK.WK1. For instructions on how to join ZiffNet, see page 12.

Disk	Type	Capacity	Size (inches)
Conner Peripherals Inc.			
Cougar 210	IDE/SCSI	210MB	3.5
Filepro 250	IDE	251MB	3.5
Filepro 340	IDE/SCSI	343MB	3.5
Summit 360	IDE/SCSI	362MB	3.5
Summit 540	IDE/SCSI	544MB	3.5
Aegean	IDE/SCSI-2	545MB	3.5
Baja	IDE/SCSI-2	1.4GB	3.5
Fujitsu Computer Products of America Inc.			
M2622T	IDE	326MB	3.5
M2622FA	SCSI	330MB	3.5
M2623T	IDE	420MB	3.5
M2623FA	SCSI	425MB	3.5
M2624T	IDE	513MB	3.5
M2624FA	SCSI	521MB	3.5
M2266	SCSI	1.1GB	5.25
M2691/94	SCSI-2	1.1GB	3.5
M2651SA	SCSI-2	1.4GB	5.25
M2652SA	SCSI-2	1.8GB	5.25
M2654SA	SCSI-2	2.1GB	5.25
Hewlett-Packard Co.			
C2233	IDE	234MB	3.5
C2234	IDE	328MB	3.5
97544 series	SCSI/SCSI-2	397MB	5.25
C2235	IDE	422MB	3.5
9754B series	SCSI/SCSI-2	795MB	5.25
97556	SCSI-2	804MB	5.25
C2247	SCSI-2	1.1GB	3.5
97549T/P	SCSI-2	1.2GB	5.25
97558	SCSI-2	1.3GB	5.25
C2488A	SCSI-2	1.6GB	3.5
97560	SCSI-2	1.6GB	5.25
C3007	SCSI-2	1.7GB	5.25
C2490A	SCSI-2	2.1GB	3.5
C3009	SCSI-2	2.2GB	5.25
C3010	SCSI-2	2.5GB	5.25
Maxtor Corp.			
7213 series	IDE/SCSI	213MB	3.5
7245 series	IDE/SCSI	245MB	3.5
LXT-340S	SCSI	340MB	3.5
7345A	IDE	345MB	3.5
MXT-540 series	IDE/SCSI-2	540MB	3.5
Panther P0-12S	SCSI	1.0GB	5.25
MXT-1240S	SCSI-2	1.2GB	3.5
Panther P0 17S	SCSI	1.5GB	5.25

Disk	Type	Capacity	Size (inches)
Quantum Corp.			
ProDrive LPS 240	IDE/SCSI-2	245MB	3.5
ProDrive LPS 525	IDE/SCSI-2	525MB	3.5
ProDrive 700	SCSI-2	700MB	3.5
ProDrive 1050	SCSI-2	1.1GB	3.5
ProDrive 1225	SCSI-2	1.2GB	3.5
Seagate Technology			
ST3243A	IDE	214MB	3.5
ST2274A	IDE	241MB	5.25
ST3283A	IDE	245MB	3.5
ST3283N	SCSI-2	249MB	3.5
ST4385N	SCSI	330MB	5.25
ST1401N	IDE/SCSI-2	338MB	3.5
ST2383A	IDE/SCSI-2	338MB	5.25
ST1480 series	IDE/SCSI-2	426MB	3.5
ST2502N	SCSI-2	435MB	5.25
ST3550A	IDE	452MB	3.5
ST3550N	SCSI-2	457MB	3.5
ST1581N	SCSI-2	525MB	3.5
ST3600N	SCSI-2	525MB	3.5
ST36010N	SCSI-2	535MB	3.5
ST3600A	IDE	540MB	3.5
ST4702N	SCSI	601MB	5.25
ST4766N	SCSI	663MB	5.25
ST4767N	SCSI-2	665MB	5.25
ST1980N	SCSI-2	860MB	3.5
ST11200 series	SCSI-2	1.0GB	3.5
ST31200 series	SCSI-2	1.0GB	3.5
ST41200N	SCSI-2	1.0GB	5.25
ST11700 series	SCSI-2	1.4GB	3.5
ST41600 series	SCSI-2	1.4GB	5.25
ST41650 series	SCSI-2	1.4GB	5.25
ST42000N	SCSI-2	1.8GB	5.25
ST42100N	SCSI-2	1.9GB	5.25
ST12400 series	SCSI-2	2.1GB	3.5
ST12550 series	SCSI-2	2.1GB	3.5
ST42400N	SCSI-2	2.1GB	5.25
ST43400 series	SCSI-2	2.9GB	5.25
Western Digital Corp.			
Caviar WDAC2200	IDE	212MB	3.5
Caviar WDAC2250	IDE	256MB	3.5
Caviar WDAC2340	IDE	341MB	3.5
Caviar WDAC2420	IDE	425MB	3.5

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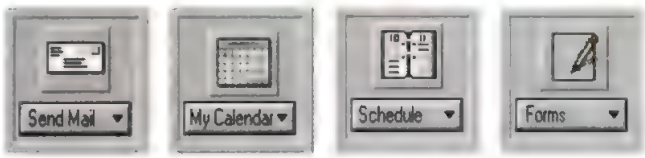

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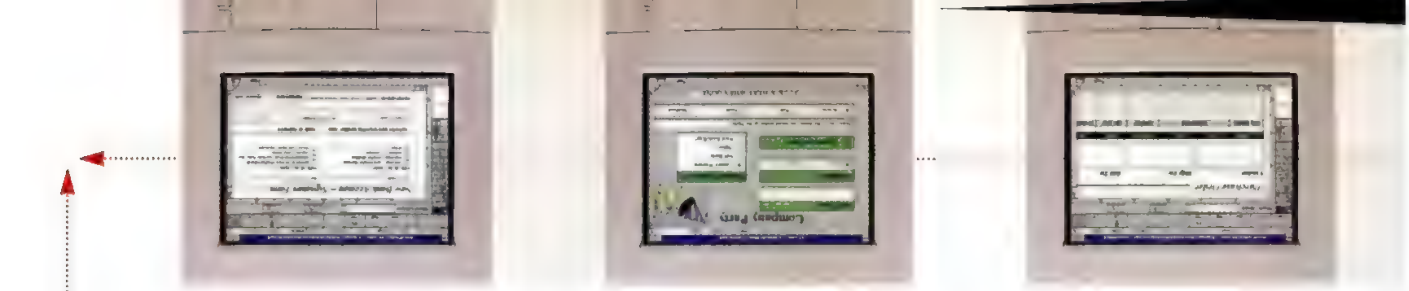

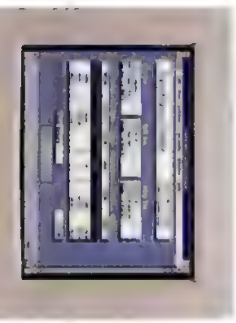

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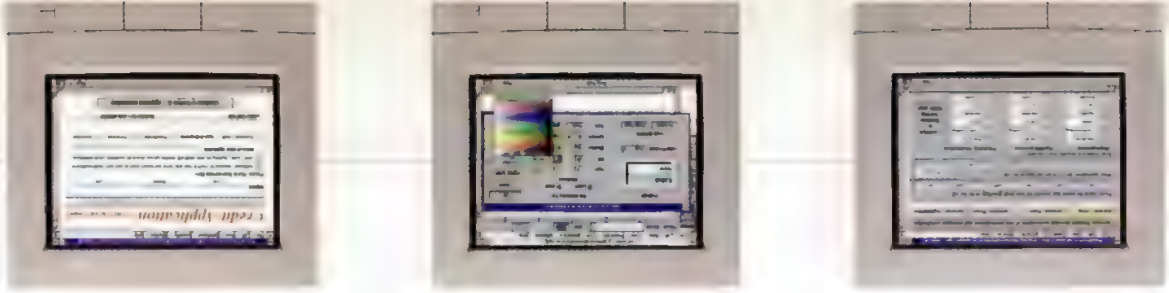

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Benchmark Tests: The Perfect Hard Disk

When shopping for your perfect hard disk, choosing between IDE and SCSI is only the first part of the decision. Hard disk controllers, hardware and software caching techniques, and expansion buses all play important, interdependent roles in determining disk subsystem performance.

What the Numbers Mean

Our testing showed that a VL-Bus configuration is a clear winner for IDE drives, but an unassisted SCSI-2 drive performs about the same on the ISA, EISA, and VL-Bus expansion buses. SCSI drive performance depends primarily on the type and cache size of the adapter used—more than IDE drive performance does. On ISA systems, adding a SCSI adapter hardware cache of 2MB generally doubles performance, and adding a 2MB software cache boosts performance an additional 20 to 30 percent on our benchmark tests.

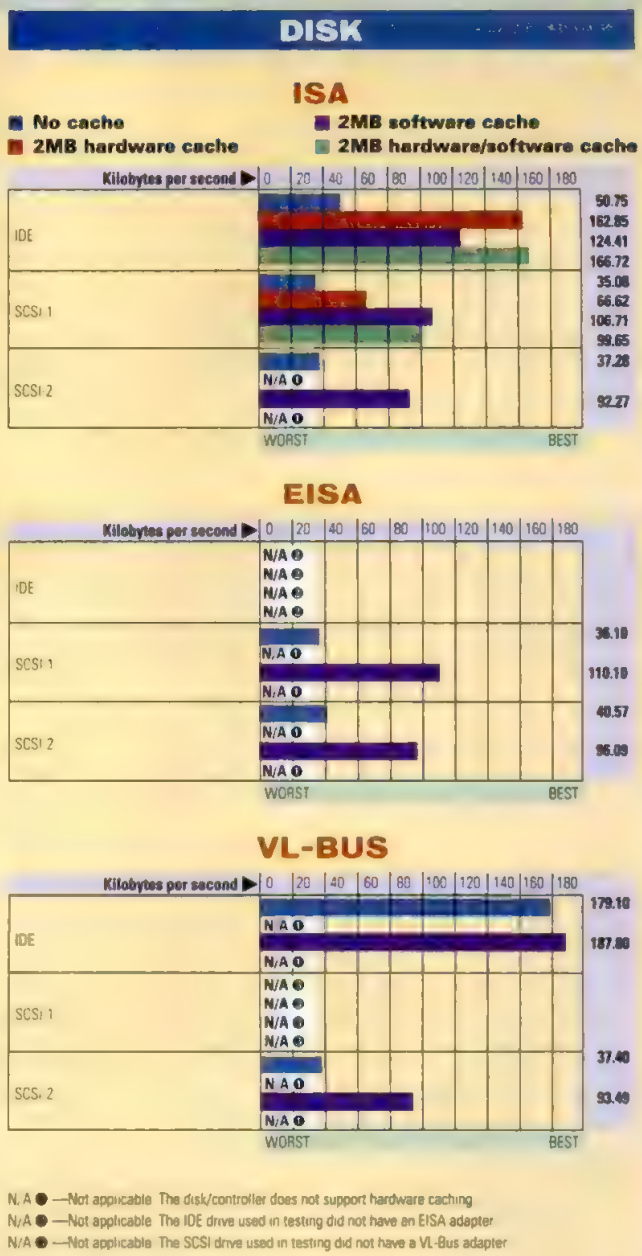
How We Tested

We tested each hard disk/controller combination in ISA, EISA, and VL-Bus configurations, initially testing each setup without cache for comparison. We used PC Magazine Labs' Hardware Benchmark Tests, Release 7.01, to measure disk throughput. Next we installed a 2MB hardware cache and reran our tests. Then we removed the cache, added a 2MB software cache to each of the disk/controller combinations that supported it, and ran our tests again. Last, we ran the tests with a 2MB hardware cache and a 2MB software cache on each of the disk/controller combinations that supported this.

For hard disk testing, we used systems provided by American Megatrends Inc. (AMI) and based on AMI's new upgradable EISA VL-Bus motherboards. These motherboards—among the first in the industry to provide an EISA VL slot—let us test ISA, EISA, and VL peripherals on the same test-bed. The units were each equipped with a 486DX/33 chip, 8MB of RAM, and a 256K Level 2 cache.

The hard disks used in this round of tests were a 540MB IDE Seagate ST3600A, a 457MB Fast SCSI-2 Seagate ST3550N, and a 525MB Fast SCSI-2 Seagate ST3600N. We tested the 457MB and 525MB Seagate disks as SCSI-1 and SCSI-2 devices, respectively. We coupled the IDE drive with a Promise Technology SuperIDE DC-200 ISA adapter, a Promise Technology DC-4030VL VL-Bus adapter, and an AMI ISA IDE adapter. Each of the SCSI-2 drives was coupled with a Distributed Processing Technology (DPT) SmartCache Plus SK2012B/95 EISA adapter, a DPT SmartCache Plus 2011/95 ISA adapter, an Alpha Research Corp. S425S ISA adapter, an AMI Series 48 Fast SCSI EISA adapter, a BusLogic BT-445S VL-bus adapter, and a BusLogic BT-545S ISA adapter. All hardware caches were set to 2MB.

For the software cache tests, we used HyperWare's HyperDisk SpeedKit 4.50, Microsoft's SmartDrive 4.0, and PC-Kwik's Super PC-Kwik 5.01. All software caches were set to 2MB.

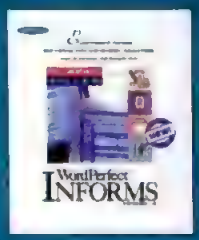


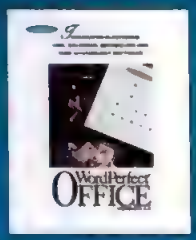
N/A ● —Not applicable The disk/controller does not support hardware caching
N/A ● —Not applicable The IDE drive used in testing did not have an EISA adapter
N/A ● —Not applicable The SCSI drive used in testing did not have a VL-Bus adapter

The DOS **disk** score measures throughput using standard DOS INT 21h file I/O calls. The score is derived from a series of tests that measure the speed of file reading and writing, both sequentially and randomly; file sizes range from 256K to 32MB.

most from the VL-Bus configuration. An IDE drive using a VL-Bus adapter was nearly 10 percent faster than a similarly configured ISA-bus model. Adding Super PC-Kwik's software cache to the VL-Bus/IDE combination resulted in the highest disk score, which represented a 5 percent improvement over the unassisted drive's score.

Test results on comparable SCSI and SCSI-2 drive configurations yielded a muddier performance picture. An unassisted SCSI-2 drive performed about the same on the ISA, EISA, and VL-Bus expansion buses. Compared with an unassisted SCSI-1 drive, however, a SCSI-2 drive delivered about 10 percent better performance.





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On an ISA system, adding a SCSI adapter hardware cache of 2MB nearly doubles performance. Further gains can be achieved by adding a 2MB software cache, boosting performance an additional 20 to 30 percent.

These test results demonstrate the fact that SCSI drive performance is primarily dependent on the type and cache size of the controller card used—more so than IDE drive performance. For example, a basic ISA IDE drive configuration is about 25 percent faster than an ISA-based SCSI-2 drive using a plain vanilla controller. On the other hand, increasing the cache size on the SCSI adapter will give you further performance gains, while IDE drives tend to peak at about 4MB.

Many advantages of SCSI—such as command queuing—are not realized on a standard DOS PC.

On our DOS Disk test, the IDE drive performed 25 to 30 percent better than comparably configured SCSI and SCSI-2 drives This somewhat surprising result can be attributed to several factors. Unlike IDE drives, SCSI drives require a microprocessor on the controller card to perform translations between DOS and the SCSI bus. The controller and accompanying SCSI software driver add overhead. Furthermore, IDE drives communicate with DOS using PIO (Program Input/Output) and Interrupt 13h, while SCSI drives rely primarily on DMA (direct memory access). In single-user systems, DMA proves to be slower (PIO can be 30 to 50 percent faster). In addition, many of the advantages of SCSI, such as command queuing, are not realized in a standard DOS PC. Only multitasking operating systems, such as those used on network servers or Unix-based high-end workstation environments, for example, can take advantage of command queuing. Finally, SCSI subsystems don't really begin to reveal their performance strengths outside of demanding environments with several devices running concurrently. So unless you plan on adding multiple SCSI devices, don't expect faster SCSI hard disk performance.

Two additional caveats: Controller and adapter cards may favor one drive over another, and adding more software caching may not result in a concomitant performance boost. For example, SmartDrive tends to perform optimally using a 2MB cache, while HyperDisk can boost performance further but needs about 8MB or more of system memory to hit its stride.

MOST OF US

For small-office and home PC users who already own ISA computers but need more storage, an IDE drive using a software cache is the best bet. Buying a state-of-the-art 200MB IDE drive will cost less than $400, and a $35 software cache will

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yield nearly the same performance as a $200 hardware cached ISA controller.

If you're purchasing a whole system, get a 340MB drive. The GUI applications of the '90s fill disk space in no time, and the additional megabytes can cost as little as $100. If the vendor offers a VL-Bus-compliant system for the same price as the ISA version, go for that too. It will guarantee top disk speed for your money.

More demanding business and Windows users also should consider the VL-Bus/IDE combination. Adding a cached VL-Bus controller will deliver maximum speed for only a couple of hundred dollars more, and your system's graphics performance will be substantially enhanced with a VL-Bus video adapter.

Power users who are delving into multimedia applications won't want to settle for anything less than a SCSI-2 subsystem, however. With a SCSI-2 drive, you can have the $2,000 2GB drive of your dreams and connect up all your SCSI devices to the same controller. A software cache will offer a performance boost, but a hardware-cached controller is the way of all data throughput. Capturing sound and video files, in particular, can easily stress out the fastest 486.

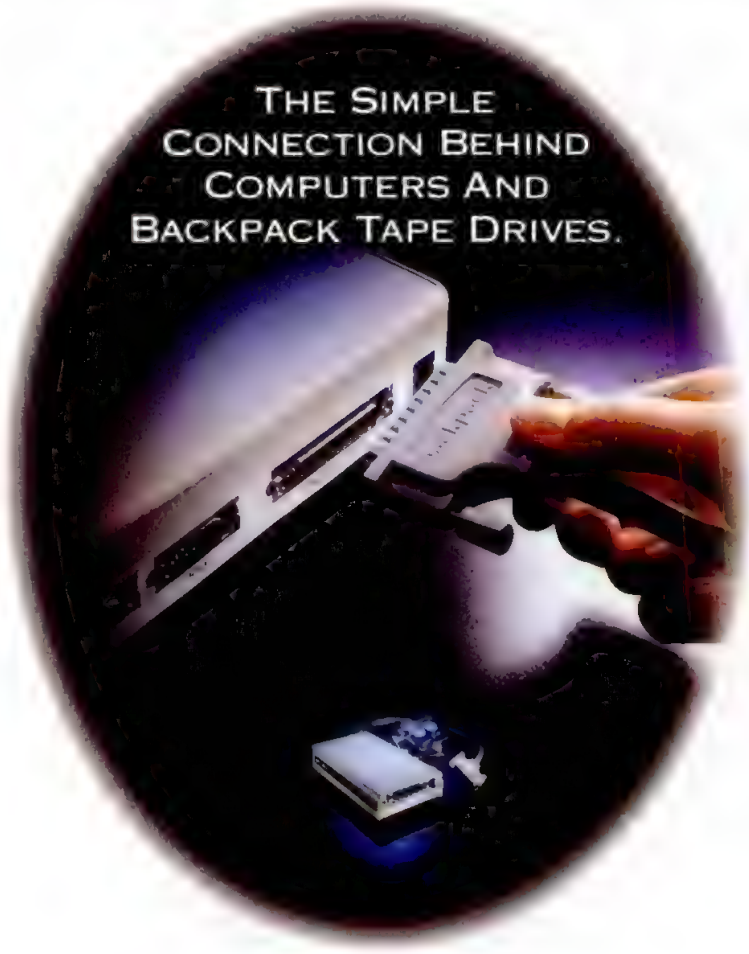
For network managers, here are three points to consider: First, you need lots of storage. Second, your software cache choices are limited. Third, because multiple users will be accessing the server's drives concurrently, you need a disk system that will keep the server's I/O bus full. All three concerns point directly at SCSI-2 drives.

In terms of network server caching, you're better off with a large hardware cache. The reason for this is that most software cache programs (and all the ones we tested) do not work with network operating systems such as Novell's NetWare. In addition, with several SCSI devices pumping data out at the same time, a larger hardware cache will help keep the data flowing. A hardware cache can conflict with NetWare's own cache, however.

Connecting all this SCSI hardware to a VL-Bus slot won't get you very much in terms of performance—yet. A VL-Bus adapter should theoretically be able to handle the 40MB per second burst modes boasted by some SCSI-2 controllers, but our tests showed that in practice, there are other factors to consider.

In the first place, because of the clock-timing cycles of a 486, I/O devices on the local bus won't show as much of a gain as devices like video adapters, which can access system memory directly. Second, the bus-mastering capabilities of today's VL-Bus machines are not as sophisticated or as mature as the bus-mastering capabilities of some EISA PCs. Depending on the memory architecture used by a VL-Bus motherboard maker, for example, additional wait states may actually be introduced in bus-mastering mode. So for LAN servers that don't require lighting-fast video, EISA still has the smarts.

Once you've decided which model to buy, make sure you maintain your investment. A well-used hard disk has to juggle



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The Perfect Hard Disk

a lot of data. Initially, all the parts of a large file will reside in a contiguous space on your hard disk. Once the file grows, though, the drive needs to find other places to put the additional data. Eventually, pieces of files end up scattered in clusters all over the drive's platter.

To clean up the mess and improve performance, defragmentation utilities—or *defraggers*—rewrite data in new contiguous files without forcing you to reformat your drive. Several inexpensive software packages are available to help you perform the chore, including Symantec Corp.'s Norton Utilities ($179; 408-253-9600), Central Point Software's PC Tools ($179; 503-690-8090), PC-Kwik's PC-Kwik Power Pak for DOS and WinMaster for Windows ($129.95 each). DOS 6.0 also includes Defrag, a subset of The Norton Utilities' SpeedDisk.

You may find you need more disk space than you can actually afford, however. If so, consider a data compression program. Today, the PC industry is pushing on-the-fly compression. Stac Electronics' Stacker ($149 list, and less than $100 through dealers; 619-431-7474) has been a perennial favorite, and now Microsoft has added a DoubleSpace compression utility to DOS 6.0. The potential benefits, reducing the size of word processing files by a ratio of 2 to 1 or database files by as much as 7 to 1, can save you the cost of another hard disk.

Meanwhile, hard disk makers continue to try to fit more bytes onto smaller drives. One such technology is magnetoresistive (MR) head design. Conventional servo voice-coil actuators and drive heads are primarily dumb amplifiers that simply pass along the signals. An MR head contains a chip that is sensitive to magnetic fluctuations, which gives it more precision in reading and writing data without making the head fly closer to the platter. This boosts disk capacities by as much as 50 percent. IBM already employs limited MR technology, and other vendors, such as Seagate, expect to release models utilizing the technology by the year's end.

Another approach is to change the type of material used for platters. Glass platters let hard disk makers increase the data capacity or bits per inch. But glass drives are still expensive. A 2.5-inch 260MB A260 IDE drive from Areal Technology (408-436-6800) is $525. Smaller still is Hewlett-Packard's $499 42.8MB glass-platter HP Kittyhawk II PSM (800-826-4111), which is only 1.3 inches in diameter and 10.5 mm thick.

Using a similar technology, Seagate is developing a drive using material created by Corning. The Canasite-based material, called MemCor, is a glass ceramic that gives drive platters a more uniform recording surface, allowing read/write heads to fly closer to the platters and cram in more information. Canasite is also more rigid than aluminum, enabling Seagate to reduce the drive size by using thinner disks.

Maxtor Corp. has a 1.8-inch drive, to be introduced later this year. Priced at around $495, the MXL-105-III will hold 105MB of data on a PCMCIA Type III card. Though PCMCIA cards were originally intended for notebook computers and hand-held personal digital assistants, Hewlett-Packard plans to introduce a desktop PC that can accommodate PCMCIA Type III cards this year.

A still more exotic design is Conner Peripherals' "wet" drives, a new technology that involves encasing the platters and head actuators in a viscous fluid to separate the drive's read/write head from the platter. Wet drives are sometimes referred to as *near contact drives* because the liquid allows the heads to fly (or, rather, swim) at less than a micron above the platter. Conner expects to introduce the first wet drives sometime next year.

The perfect hard disk of the future may not be a hard disk at all. Intel Corp. and Conner recently demonstrated a 42.5MB flash memory card prototype. Plugging such faster and nearly indestructible "drives" into your PC could be as easy as putting your bank card into an ATM. But don't expect to see 300MB storage cards on the desktop anytime soon; flash memory is expensive and difficult to manufacture.

Meanwhile, plenty of inexpensive hard disk options are available. Budget and small-office users should read the first part of this issue's roundup of IDE drives, "Movin' On Up: Hard Disk Upgrades." Those shopping for primary storage should check out part two of that story, "Making the Buy." □

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The PERFECT ACCESSORIES

SO YOU WANT TO OUTFIT YOUR DREAM PC WITH THE ULTIMATE PERIPHERALS? TRY THESE KEYBOARDS, SOUND BOARDS, AND MICE ON FOR SIZE.

BY MITT JONES

Those truly on the quest for the perfect PC will want to surface occasionally from the world of upgradable processors and local-bus video to agonize over other details. Most of us could eventually adapt to nearly any keyboard, while all but a few could tolerate any competent pointing device. And only a hopeless crank could fail to appreciate any respectable sound board or external sound device at least somewhat, given the PC's historic lack of musical ability.

But the Perfect PC isn't about adapting, tolerating, or even appreciating. It's about finding, building, or pulling together a system that ideally suits not just your needs but your tastes as well. And never will you find offerings that appeal to a greater range of needs and tastes than when considering the keyboard, pointing device, and sound board that will complete your own Perfect PC.

Here we devote a few pages to describing the available options across these three product categories, and to helping you choose which of these products will best meet your needs.

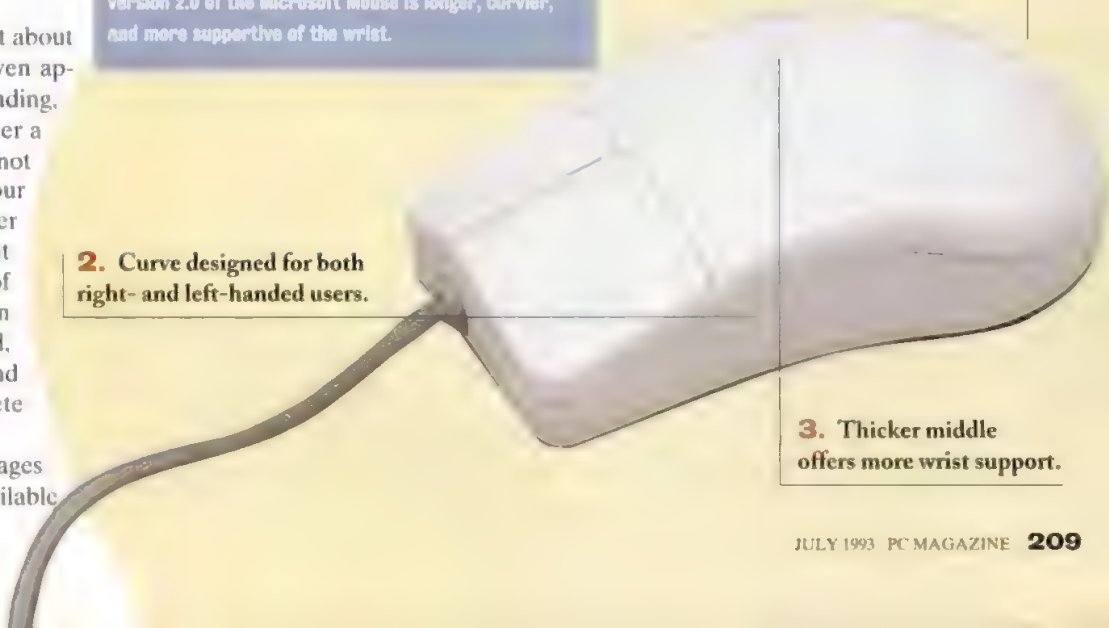
A CLICKISH BUSINESS

Nothing can spoil the feel of a sturdy, gigabyte-laden power PC quite like a nondescript, insubstantial keyboard. And by the same token, a first-rate keyboard can make even the flimsiest clone feel like a winner.

Keyboard connoisseurs have traditionally divided keyboards into two categories: those based on mechanical key switches and those based on key switches of the membrane variety. Today, however, we need categories that observe a distinction between two different components of every key switch: the portion that provides for the up-and-down motion of each key—the key-switch actuator—and

Building a Better Mouse

The PC's most familiar pointing device has a successor: Version 2.0 of the Microsoft Mouse is longer, curvier, and more supportive of the wrist.



the means by which the press of a given key causes an electrical connection to be made—the switch itself.

Most modern keyboards, including the IBM and Lexmark keyboards made by Lexmark International, use membrane-switch technology, in which a layer of insulating material with carefully positioned holes separates two layers of film, each silk-screened with conductive ink. When you press a key, no matter what type of actuator it uses, some part of the actuator compresses the membrane, causing the conductive ink of the two outer layers to make contact through a hole in the insulation layer.

Some keyboards, such as Northgate Computer Systems' offerings, still provide the necessary electrical contacts more directly, as a metal ring at the bottom of the key butts into two electrical contacts each time a key is pressed. But the key actuator itself proves the most important contributor to what sort of feel the keyboard will give the user.

Lexmark/IBM keyboards have remained leaders, at least where the feel of the keys is concerned, primarily through their patented use of buckling-spring actuators. With these actuators, each time a key is pressed, a tiny metal spring underneath the key buckles as it descends. This buckling provides both the snappy feel of the keystroke and the audible click, which is caused by the spring's snapping into the side of the plastic key actuator frame as it buckles. Those users who remember the original IBM XT and AT keyboards, when the company hadn't yet made the transition to membrane switching, may be somewhat disappointed with the current keyboard feel, but the same buckling-spring mechanism supplies at least most of the old snap and click feel of the more tradi-

Our Contributors: MITT JONES and M. DAVID STONE are contributing editors to *PC Magazine*. STEVE RIGNEY is a network consultant and frequent contributor to *PC Magazine*. GAYLE C. EHRENMAN was the associate editor in charge of this story, and JEFF MACE was the project leader.

HIGHLIGHTS

Buying the Perfect Accessories

MOST MODERN KEYBOARDS use membrane-switch technology, which provides a low noise level. But many users still prefer the snappy, mechanical feel of keyboards with spring-based actuators.

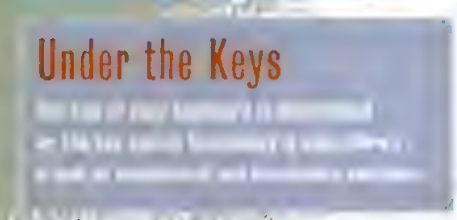
CARPAL TUNNEL SYNDROME has sparked some keyboard manufacturers to find innovative ways of placing the keys in a more healthful typing position, typically by separating or bending the keyboard into two halves.

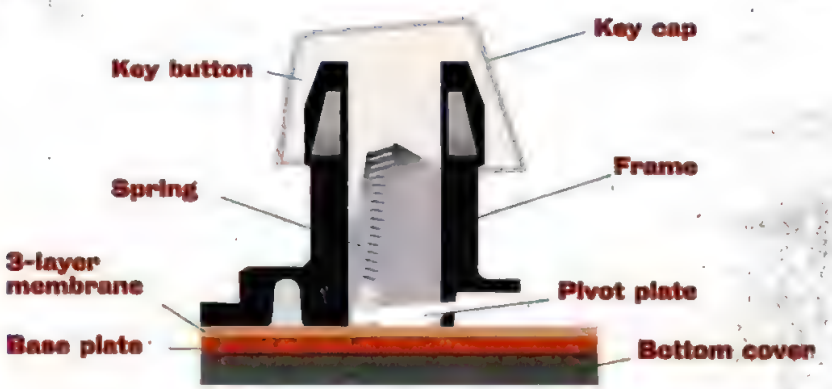
TRACKBALLS provide the perfect pointing solution for those who want the functions of a mouse without using as much desktop space.

DIGITIZER TABLETS are gaining popularity as alternate input devices because they make it easy to reproduce or edit drawings, and they give artists control similar to what they would have with pen and ink. Prices range from $275 to several thousand dollars for larger tablets with cordless transducers.

SOUND BOARD PRICES have dropped enough to make it possible for nearly everyone to add sound to a desktop PC. Whether you need one of the more sophisticated boards or a lower-priced option will depend on whether your primary goal is to compose music or simply to hear the sound effects of video games.

ALTERNATIVE SOUND DEVICES offer simple installation by plugging into the parallel port, making them ideal for users who need audio capability with their notebook computers.





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tional mechanical-switch keyboards.

Once available only with the purchase of IBM machines, IBM keyboards have been available separately through its dealers for some time. Since April 1, 1992, however, Lexmark International (800-438-2468) has been selling the same keyboards via mail under its own label.

Lexmark and IBM certainly don't have a patent on the use of the springs in general, and some other companies market keyboards with spring-based actuators that provide something close to the same snap and click feel. The $89 OmniKey/101NI from Northgate (800-548-1993), and the $49.99 KB-5181 by Chicony America (714-630-6662), are notable examples. Both use ALPS mechanical switches, and both—particularly Northgate's offering—feel solid and substantial. Chicony adds a novel touch to its mechanical-switch model: a hard plastic keyboard dust cover that protects those precious keys from the elements. The $99.95 Tandy 101-Key Enhanced Keyboard also offers a mechanical touch that feels almost like the IBM's, and is packaged in a solid, well-made housing.

Membrane keyboards have historically offered a soft, rubbery feel that differs from the Lexmark/IBM feel.

SILENCE, PLEASE

Membrane keyboards—those that use rubber-dome actuators—have historically offered a soft, rubbery feel that differs quite a bit from the traditional Lexmark/IBM approach. Instead of placing a spring under each key, these keyboards use a rubber dome designed to give slowly at first and then to collapse abruptly when a key is pressed.

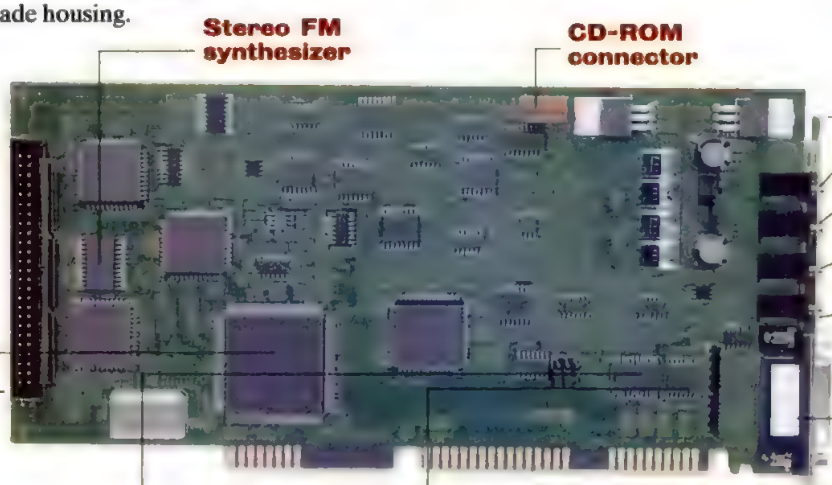
One advantage of this approach for some end users is its low noise level; others just like the soft touch. Users who appreciate the softer feel traditionally associated with membrane keyboards may find that the keyboard that ships with their clone will offer just what they want. If not, plenty of low-cost options are available, including the $31 NMB RT-101 + Membrane (Space Saver) by NMB Technologies (818-341-3355 ext. 589).

If you prefer a quiet keyboard but don't want to give up the snappy, mechanical feel associated with spring-based actuators, Lexmark has a product that may be just what you need. The $89 Quiet Touch Keyboard uses rubber-dome actuators, but simulates the feel of a spring-type actuator without the noise.

One note of caution: The Quiet Touch, which eliminates the numeric keypad, provides only 84 keys, and Lexmark further reduced space requirements by moving about some of the ancillary keys. This reduces the size of the keyboard to a mere 13 inches wide by 6.3 inches deep, which conserves desk space but also requires an adjustment from the user.

If a downsized keyboard appeals to you, but you don't want to pass up the traditional Lexmark/IBM keyboard feel, you're in luck: The $99 Lexmark Streamlined Keyboard offers the same buckling-spring actuator, the same layout and features as the standard 101-key model, but eliminates unused space above the function keys and along the other three edges of the keyboard, reducing its width from 19.4 to 17.75 inches and its depth from 8.3 to 6.2 inches.

Those of us who still prefer our function keys in two columns along the left edge of the keyboard—the arrangement used in the original IBM XT and AT—have at least one attractive option left: the $129 Northgate OmniKey/Ultra-T. The Ultra-T provides a full 101-key layout plus an additional set of 12 function keys in two columns on the left side. The keyboard, which uses the same ALPS mechanical switches as Northgate's other



Anatomy of a Sound Board

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offerings, also allows you to customize key assignments.

If you like function keys along the left, for example, chances are you also like the Ctrl, Shift, and Alt keys placed in a straight line, from top to bottom, along the left of the alphanumeric keypad. The Northgate keyboard allows you to make this change by assigning those functions to the extra keys along the left side of the keyboard.

Another notable entry—the $99 ProKey 124 by Maxi Switch, available from Ingram Micro (714-566-1000)—provides blank keys along the left that can be easily programmed as a second set of function keys. This keyboard lacks the hefty feel of Northgate's offerings but will give you customization options the Northgates don't. With the ProKey 124, any key can be programmed with keystroke macros totalling 1,800 characters.

ERGONOMIC ALTERNATIVES

Now that Carpal Tunnel Syndrome has become a serious concern, both for users of keyboards and for companies that must pay health-care costs, some companies are incorporating what is essentially the standard collection of keys into a design that places the hands in a healthier position for typing. These companies include Applied Learning Corp. (215-688-6866), Health Care Keyboard (414-253-4131), and Kinesis Corp. (206-455-9220).

Most of these companies use some method of separating or bending the keyboard into two ergonomic halves. An alternate approach, called chording, calls for keys to be manipulated in combinations—or chords—either with one hand or two to mimic the capabilities of standard keyboards. Companies selling such products include AccuCorp (703-961-3576), Handykey (800-638-2352), and Infogrip (800-397-0921).

Without a doubt, the best course of action when it comes to finding the keyboard that feels right to you is to try the product before you buy it. If this isn't possible, make sure that you buy your keyboard from a mail-order company or retailer that will allow you to return the keyboard, no questions asked, within a given period of time.

MOUSE ELIMINATORS

The final group of keyboard offerings, and one that is growing fairly rapidly, comprises products that take one of two approaches to building pointing capability into the keyboard: integrating a trackball into the keyboard design or, an even more novel approach, building the pointing capability into the mechanism of a key, often the "j" key. None of these products will likely prove ideal for those who need a mouse for more than navigation through a document, but they can be appealing options for those who don't want a space-consuming mouse.

Carpal Tunnel Syndrome has become a serious concern, resulting in new, more healthful keyboard designs.

The $149 Lexmark Enhanced 101-Key Keyboard with Integrated 25mm Trackball or 16mm Trackball places a medium-sized trackball and two sets of buttons along an incline in the upper right corner, above the indicator lights, of an otherwise standard keyboard. The design, which allows you to use the trackball by resting your arm along the right side of the keyboard, proves surprisingly convenient and comfortable during use. The trackball is Microsoft-compatible.

The idea behind a trackball—flipping a mouse over, in effect, to provide the same functions without requiring as much desktop space—has been an attractive one for some time. But despite their growing popularity (a trend no doubt attributable to the proliferation of both laptops and Microsoft Windows), trackballs still place a distant second in sales behind mice. For many users, the problem is simply a matter of feel: The trackball can be uncomfortable to use at first.

One product that stands a good chance of changing users' minds about trackballs deserves a closer look if you think you'd like to rid yourself of your desktop mouse. The $139 TrackMan by Logitech (800-231-7717), which measures a sizable 5.5 inches wide by 5.4 inches deep, sits firmly on the desktop and is designed to support the user's hand in a comfortable, relaxed position. Provided that your hands aren't unusually small or large, each of your three longer fingers should rest naturally on one of the three buttons, and your thumb should rest atop the relatively large ball itself. As with most other trackball offerings, the TrackMan is Microsoft Mouse–compatible, so software support won't be a problem.

You'll find numerous smaller trackball offerings designed to attach to the side of a laptop. The $175 Microsoft BallPoint Mouse and $169 Logitech TrackMan Portable rank among the best, although neither can match a standard mouse or full-size trackball for ease of use.

MICE

Although more people are finding trackballs to be an attractive option, the fact remains that most users simply find it easier to shift a mouse about a desktop with the wrist and hand than to roll a ball with the thumb, particularly when a wide range of movement or a great deal of precision is required. As with keyboards, one of the most important considerations with mice boils down to a matter of individual needs and tastes.

Most users prefer a mouse that feels substantial and moves smoothly; mice by Logitech and Microsoft (800-426-9400) have long dominated the market by doing both. Both companies have also concentrated a great deal on providing an ergonomic mouse design. The resulting shape of the ever-popular Microsoft Mouse ($125 for bus version, $109 for serial or PS/2 version) and of the $119 Logitech MouseMan has been referred to as the "Dove bar" design, named after the soap.

During this project, Microsoft submitted an early production unit of its next-generation mouse, which should be shipping in quantity by the time you read this. The Microsoft Mouse, Version 2.0, priced at $109 for the serial version, improves on the Dove bar shape with a significantly larger, more bulbous design that curves substantially to the left. The largeness and odd shape will feel a bit strange at first to those accustomed to less curvaceous mice, but the new design

Editors' Choice Recap

Keyboards: *February 25, 1992*

- **Lexmark Enhanced 101-Key Keyboard**
- **Northgate OmniKey/101NI**
- **Northgate OmniKey/Ultra-T**

Weighing in at 5 pounds, the Lexmark Enhanced 101-Key Keyboard won our Editors' Choice award in the February 25, 1992, keyboard roundup because it's built to last and is compatible with virtually all AT-class hardware. Despite having a slightly heavy touch, it was noted for having the most solid feel of the products reviewed, and for providing the most positive tactile feedback via its spring-actuated keys.

The Northgate OmniKey/Ultra-T was cited as "the best choice by far" of the keyboards reviewed. Providing a full 101-key layout, it's designed with an additional set of function keys in two columns to the left, which makes for easier typing of DOS pathnames. The OmniKey/Ultra-T also places the Ctrl, Shift, and Alt keys on the left side.

Like the OmniKey/Ultra-T, the Northgate OmniKey/101NI allows you to customize virtually every detail of its operation, and it uses ALPS mechanical switches to offer a snappy, clicky touch. Both keyboards have a metal base and plastic case, making them among the heaviest and most substantial-feeling keyboards on the market.

Sound Boards: *April 27, 1993*

- **CompuAdd Spectrum 16 Multimedia Sound Card**
- **Media Vision Pro AudioSpectrum 16**
- **Turtle Beach MultiSound**

In our review of 25 sound boards, the Turtle Beach MultiSound earned an Editors' Choice "because it simply has no peer among its competitors." Using the synth chips of E-mu Systems' Proteus 1XR, MultiSound relies on actual sampled instrument sounds stored in 4MB of ROM, making it the only product reviewed that consistently provided CD-quality audio.

The CompuAdd Spectrum 16 Multimedia Sound Card ($250) and the Media Vision Pro AudioSpectrum 16 ($299) were cited for their flexibility and moderate prices. (CompuAdd resells Media Vision's board, changing only the bundled software.) Both are 16-bit boards that support 44.1-kHz sampling and ADPCM compression and decompression. Both products offer up to 20 simultaneous multitimbral voices using the four-operator Yamaha OPL3 FM synthesizer. Both boards are also Ad-Lib– and Sound-Blaster-compatible. □

does more closely fit the hollow of a cupped hand, and because the back end of the mouse is higher, it supports the hand better.

Logitech was also preparing to announce its redesigned MouseMan Cordless Radio Mouse II as this project was nearing its end. Cordless mice are nothing new, but older models used infrared beams, which tended to be problematic, in part because the mouse would cease to work whenever any object broke the path of the beam. Like its predecessor, this new $149 offering uses radio signals to eliminate blockage problems. In addition, Logitech reports that it has redesigned the shape of its existing radio mouse to make it fit the shape of a cupped hand more closely.

Yet another ergonomic Logitech offering should be a top choice if your Perfect PC will be used by a pre-teen with small hands. The colorful, $59 Kidz Mouse is shaped, well, like a field mouse and was designed to fit small hands. It also comes bundled with mouse software that is specially designed to be used by children.

When it comes to their inner workings, most modern mice resemble each other more than they differ, at least in the methods they use to detect and indicate movement. Until Version 2.0 of the Microsoft Mouse came along, Microsoft remained among the few companies persisting with a mechanical mouse design. With this earlier, mechanical design, when the mouse moved, the rubber roller ball at the bottom of the mouse turned metal rollers inside the mouse, which in turn spun wheels fitted with electrical contacts. Metal brushes provided the other necessary contact.

Version 2.0 of the Microsoft Mouse joins the great bulk of its competition, including the Logitech offerings, in using a more reliable, optomechanical design. The mechanism is roughly the same as in the previous version, with a rolling rubber ball at the bottom, but here the spinning wheels feature slots rather than electrical contacts. A light source and sensor are positioned so that the light can pass through an appropriately positioned slot. As the wheels turn, the sensor detects pulses of light that indicate mouse movement.

A third category, optical mice, have virtually no moving parts, making them even less prone to wear. These mice gauge movement by bouncing light from LEDs (light-emitting diodes) on the bottom of the mouse off of a special pad imprinted with a finely laid grid. They also boast better accuracy than their mechanical and optomechanical competitors, though only the most exacting CAD user or graphics artist is likely to notice the difference. The problem with optical mice is that they require you to operate them on their pads and to keep the pads clean and uncluttered. Check out the $149 PC Mouse III from Mouse Systems Corp. (510-656-1117) if this sounds like the technology for you.

RESOLUTION

Both Logitech and Microsoft have settled on 400-cpi (counts per inch) as the optimal hardware resolution of their mice, and this is as high a resolution as the majority of us will need. If you happen to spot other companies touting resolutions of up to 1,800-cpi, don't be fooled: These manufacturers are advertising resolution as enhanced through software, a capability that every mouse offers.

The Perfect Accessories

When mouse vendors talk about hardware resolution—more accurately referred to as senstivity—they are talking about how many counts of movement per inch the mouse registers on your desktop. How those units are translated into movement of the pointer on-screen, however, is determined by the mouse driver. Any mouse worth the plastic in its housing will provide an easy way for users to adjust this relationship. At too low a level of sensitivity, you'll find yourself having to shift the mouse several times just to move the pointer across the screen. At too high a level, a slight movement throws the pointer farther than you intended.

Most mice also include some form of adjustable cursor acceleration: When you move the mouse quickly, the sensitivity increases; when you move the mouse slowly, the sensitivity decreases. This ability to adjust the apparent resolution of a mouse means that you could probably get by with a 200- or 300-cpi device, as long as your work doesn't involve a great deal of detailed graphics. For most of us, however, a 400-cpi mouse makes sense. The step up in price is minimal, and the higher resolution should help ensure that your mouse can perform with the mix of speed and precision that your applications demand.

THE GREAT BUTTON DEBATE

Just as the perfect PC must have the perfect mouse, the perfect mouse must have the ideal number of buttons. Microsoft has long held that two buttons is enough, particularly given that most software packages traditionally didn't make use of the second button, and that having three buttons significantly increases the likelihood that a person will accidentally click the wrong button.

Logitech, on the other hand, has noted with equal conviction that three-button mice give the user more flexibility when it comes to assigning functions or keystrokes to buttons through the mouse's own software, particularly at a time when a growing number of packages are making use of the right mouse button.

Logitech has noted that three-button mice give the user more flexibility when assigning functions to buttons.

Both companies are right. If you're the kind of person who likes to take things out of the box, plug them in, and tinker no more, a two-button mouse is probably the thing for you. If one of your favorite pastimes is customizing your applications to reduce keystrokes and to operate more effectively, then a three-button mouse may better suit your tastes.

If you really like the idea of assigning lots of keystrokes to the buttons on your mouse, you might want to consider one of the PowerMouse models from Prohance Technologies (415-967-5774). The $99 PowerMouse 50 comes with 12 but-

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Choosing the Perfect Modem

by M. David Stone

Choosing a modem has much in common with choosing a sound system for your car. Neither choice has any effect on how well the underlying machine functions, but either one can make a big difference in driving satisfaction. With modems, however, you may be surprised to find that the range of choices today is much greater than ever before. And given that you can mix and match features, you'll want to make sure you get the right combination for your needs.

Start by deciding which protocols you want. Modulation protocols define modulation scheme and speed, and are the foundation for every connection. Error control protocols—which let the receiving modem detect errors and request a repeat—are only slightly less important. At 9,600 bits per second (bps) and above, where even a short burst of noise can garble a great deal of data, error control is critical. At lower speeds, it's a useful luxury. Data compression protocols—which let the sending modem detect patterns in data, code them as short tokens, and send just the tokens along with a translation dictionary—can speed throughput at any modem speed.

As may seem obvious, you can't establish a link between two modems unless you match modulation protocols, and you can't use error control or data compression unless both modems follow the same rules. Choosing error control and data compression protocols is easy. There are only two widely used schemes for each—V.42 and MNP 4 for error control, and V.42bis and MNP 5 for data compression—and virtually all modems today either offer all four schemes, or none.

The list of modulation protocols is much longer, but the choices are straightforward. If your needs are minimal—limited to sending and receiving short e-mail messages for example—you'll be perfectly happy with a 2,400-bps V.22bis modem, even without error control or data compression. Given that you can stay below $100 even with these extras, however, and that both are becoming stock features for 9,600-bps or faster modems, it's hard to recommend going without them. Higher speed modems are now inexpensive enough that you might consider buying one even if you only need 2,400 bps.

Choosing error control and data compression protocols is easy—there are only two widely used schemes.

BUILT FOR SPEED

For heavy-duty communications—transferring large files or using a remote operations program for example—you'll want as much speed as you can get. That means 14,400 bps with V.32bis. You can still find 9,600-bps V.32 modems, but with street prices for V.32bis dipping below $200, there is little reason to go with the slower speed. And insist on V.42bis and MNP 5 data compression for any V.32 or V.32bis modem. (If you decide on V.32bis, or want specific product information, see the performance results in "Life in the Fast Lane" in the June 29, 1993, issue of *PC Magazine*.)

Be certain you don't overlook older, slower protocols. Any modem should offer V.22bis for 2,400 bps. And virtually any will offer Bell 103 for 0 to 300 bps and Bell 212 for 1,200 bps. You may need these protocols if you're trying to talk to older modems, or if you need to communicate reliably over poor phone lines, especially in foreign countries. If you communicate outside of the U.S. you should look for the equivalent worldwide CCITT (International Telegraph and Telephone Consultative Committee) standards: V.22 for 1,200 bps and the somewhat less common V.21 for 300 bps.

You might also want to consider a fax modem. Virtually any modem with fax today offers Group 3 compatibility at 9,600 bps. If faxing is particularly important, look for V.17 protocol, for Group 3 faxing at up to 14,400 bps. And if you need to communicate with an older, Group 2 fax machine, you can find modems with Group 2 support as well. For maximum flexibility in choosing fax software, be sure the modem provides a standard language for fax control—Class 1, Class 2, or Class 2.0. (Class 2 isn't really a standard, but is rather various manufacturers' implementations of an earlier, proposed version of Class 2.0. It is widely supported in software, however.)

Consider convenience features, also. If you want one less item on your desk, or one less to carry with your portable computer, you may want an internal modem. But if you're more concerned with being able to spot and fix communications problems, you'll want an external modem that shows status information. For V.32 and V.32bis modems, an LCD will provide you with more of the information you need than a simple status light will. And if desktop space is at a premium, look for a modem that you can fit under your phone.

For maximum compatibility with software, finally, you should shy away from modems that have unusual command sets. Instead, look for a modem that closely follows one of the Hayes Smartmodem command sets for most of its commands, and follows either Hayes or Microcom commands for features related to error control and data compression. □

tons and accommodates as many as 72 programmable functions, while the $125 PowerMouse 70 sports 17 buttons and allows 102 functions, and the granddaddy of them all, the $175 PowerMouse 100, provides 40 buttons and 240 programmable functions. These units are slightly larger than the average mouse, and have what look like calculator buttons built into the top of the devices. They are designed to fit comfortably in the hand during use.

Try not to lose too much sleep over compatibility when choosing a mouse: The Microsoft Windows software contains mouse drivers for several major manufacturers, and the majority of mice on the market are compatible with the Microsoft Mouse, which should be supported by any piece of mouse-friendly software. If you want to play it really safe, just remember one very basic rule: If the product is not Microsoft Mouse–compatible, or Mouse Systems–compatible at the very least, do not buy it.

And as with keyboards, to ensure that the mouse you choose will suit your particular tastes, your best bet is to try it out at a local retailer or to buy it from a mail-order house that will accept returns.

PEN WINDOWS, ANYONE?

Graphics artists and CAD professionals have long enjoyed the benefits of digitizer tablets. Now, Microsoft Windows for Pen Computing and GO Corp.'s PenPoint and PenDOS (see *PC Magazine,* Nov 10, 1992) have finally given the rest of us at least a passable excuse to indulge. Hardware vendors have also helped out by bundling Microsoft Windows for Pen Computing with new, inexpensive, downsized digitizer tablets—such as the $275 NotePad, from CalComp Digitizer Division (800-932-1212) and the $349 PenMate, from Mouse Systems Corp.—for those of us who want to experience what pen computing is all about.

A digitizer tablet and its drawing tools—the tablet's standard selling price usually includes your choice of either a pen, or stylus, or a mouse-like "cursor"—are the electronic equivalents of pen and paper. You can sketch out a quick design on the digitizer tablet with the stylus, for instance, and watch your sketch appear on screen. Digitizer tablets are popular accessories because their pressure-sensitive drawing tools afford artists some semblance of the control they might have with traditional media. For example, pressing harder with the stylus increases the resulting line's thickness and gives the line a more hand-drawn appearance. The user can also lay the paper versions of blueprints or other drawings onto the tablet and trace over them.

These traditional functions of digitizer tablets require the use of absolute coordinates: Each position of the digitizer tablet maps to a logical position of the screen. For those times when the relative positioning of a mouse or trackball would seem more natural, however, most tablets now provide the ability to emulate the Microsoft mouse.

Digitizer tablets range in price from $275, for the aforementioned CalComp NotePad with Windows for Pen Computing, to a ceiling of several thousand dol-

INFOWORLD MAGAZINE NAMED
THE COMPAQ PROSIGNIA
SYSTEMS PRODUCT OF THE YEAR.

Building the Perfect Network

by Steve Rigney

The perfect PC is a networked PC. But with so many networking options, how do you choose the perfect network?

The first step is to plan the LAN. The only way to avoid the pitfalls of IRQ conflicts, limited memory, and hardware incompatibilities is to have a detailed picture of every PC on the network. You'll also want to make sure that all of the applications you currently own are networkable; if they're not, find out if a network version is available. Don't assume that your programs will automatically work on a network.

Once you know the number and configuration of the PCs you plan to link, you can choose a network architecture. The two most popular types are Ethernet, an inexpensive and effective solution for small-to-midsize networks, and Token-Ring, a somewhat more complex solution suitable for larger installations and especially important for networks connecting to IBM midframe and mainframe computers. Both are suitable for peer-to-peer networks, in which every PC shares data and applications with every other; and dedicated-server networks, in which a number of client PCs borrow files and applications from a central server.

You can purchase your network adapters once you've chosen your network architecture. Keep in mind that a network adapter must be compatible with the computer in which it's seated, with the network cabling, and with the network operating system. The perfect LAN adapter card has connectors for both unshielded twisted-pair wire and some other kind of cabling. It also shouldn't place a load on the PC's processor, so it should probably have a minimum of 32K of on-board memory. Since most users' PCs don't take advantage of 32-bit capabilities, you are probably safe buying adapter cards that use only 16-bit addressing. However, your server should be the fastest and most advanced PC in the office; it should support 32-bit addressing, as should its adapter card.

Your network server should be the fastest and most advanced PC in the office, and should support 32-bit addressing.

As you'll see when looking at the cards, each LAN architecture requires different cabling. Cabling types are specified by the committees that write the standards for the various architectures. Make sure that the cable you purchase meets EIA/TIA (Electronics Industry Association/Telecommunications Industry Association) testing standards. Have each leg tested, and keep the test results for future troubleshooting.

While planning your LAN's layout and architecture, consider the layout of the workspace. If you are networking three PCs in the same small room, you could probably get away with running cable behind the desks and along the wall, but if you have a large installation or one with significant architectural barriers, wiring your system could involve running cable through walls or even between floors.

Next, you'll need to choose your network operating system. Ideally, a network operating system should provide both peer-to-peer and dedicated server capabilities. You might have to mix and match products like Novell's NetWare and Webcorp's WEB for Windows and DOS, or Microsoft Windows for Workgroups and Performance Technology's POWERlan to achieve this, but you shouldn't be limited to only one architecture.

The software you are currently using, as well as the software system you wish to implement in the future, should play a major role when you are choosing your network operating system. For example, if you need the functionality of a client/server SQL database (for which the server takes on much of the load for processing and supplying files), you must use a server-based network operating system such as Novell's NetWare or Microsoft's LAN Manager. If you are only doing word processing or data entry, then a peer-to-peer LAN such as LANtastic may provide all the power you need.

MANAGING YOUR NETWORK

On the perfect network, you can manage not only individual PCs but important peripherals such as an uninterruptable power supplies and wiring hubs. A smart wiring hub used in conjunction with network management software can provide complete network management for every component of your network. Network management allows you to keep tabs on your network traffic, and offers early warning against problems that cause network downtime. Properly implemented management will prevent problems and save hours of troubleshooting time.

To make your network even more useful, you'll want to make sure that it has dial-in/dial-out capability. There are a number of products, such as the U.S. Robotics Communications Server 386, that will allow you to dial in to the network from a remote location, and allow you to dial out across the network.

The perfect network must be carefully designed around your existing hardware, software, and office environment. There are many equally useful options, but if you design your network thoughtfully you'll be able to handle years of changes and upgrades. □

lars. The two entry-level models previously noted—CalComp's NotePad and Mouse Systems' PenMate—offer such low prices in part because of their relatively small size. The NotePad provides an active working area of 7.5 by 7.5 inches, while the PenMate features a working area that measures 6 by 9 inches.

For a relatively small jump in price—up to $470 if you want Microsoft Windows for Pen Computing bundled with the product—you can buy CalComp's entry-level professional offering. The DrawingPad, which lists at $395 without Windows for Pen Computing, offers the same 7.5- by 7.5-inch working area as the NotePad, but unlike the less-expensive CalComp and Mouse Systems offerings, uses cordless pens and/or cursors. It also offers a pen that is pressure-sensitive, an important consideration if you'll be using your digitizer tablet to create drawings or illustrations.

CalComp's midrange offering, the DrawingBoard II, serves as a good indication of the kind of pricing you should expect for more expensive digitizer tablets. CalComp offers the DrawingBoard II in six sizes, which range from 12 by 12 inches to 44 by 60 inches. All of these instruments come in cordless versions as well, an option that costs an additional $150. This makes for a range in list prices that begins at $495 for a 12- by 12-inch tablet with corded transducer (pen or cursor) and extends to $3,145 for a 44- by 60-inch model with a cordless transducer. Buyers who need Microsoft Windows for Pen Computing will need to add $75 to the respective list prices of any of these models.

SOUND BOARDS

Those who suspect they may be missing an essential, if relatively new, part of the PC experience by lacking a sound peripheral should have no problem finding a card or an external solution that fits both their needs and their budgets. The list of offerings just keeps growing and the prices keep falling accordingly. *PC Magazine* reviewed 25 audio products in this year's April 27 issue, and several offerings—perhaps the most notable being the $179 Logitech AudioMan—have since surfaced. Suggested list prices range from a low of $129 for the ATI Stereo-F/X to the $599 Turtle Beach MultiSound, with street prices dipping below $100 at the low end.

Several offerings—including Logitech's AudioMan, the $199 Media Vision AudioPort, and the $198.95 Digispeech Port-Able Sound—install in a snap simply by plugging into the parallel port, a development that should prove particularly pleasing to those who need audio with their laptops on the road. All three models run off of AA batteries and integrate a speaker into their external units. The Logitech and Digispeech offerings also include a built-in microphone and provide a pass-through connector for the simultaneous connection of a printer.

The disparity in pricing among the sound products currently available underscores the obvious: Not all audio products are alike. More importantly, no one product does it all.

Sparked by the audio capabilities built into Windows 3.1 and the environment's

FOR THE THIRD YEAR IN A ROW,
LAN TIMES READERS CHOSE
COMPAQ SERVERS OVER EVERY
OTHER BRAND.

ability to attach sound to files through Object Linking and Embedding (OLE), the development of audio products geared for the mainstream business user has begun to produce some interesting results.

Logitech designed its AudioMan primarily for users who want to enhance their productivity or enliven presentations by attaching voice-quality audio to files within Windows 3.1. Common uses for this capability might include attaching a voice note to a spreadsheet cell or e-mail message, or sprucing up a presentation with a voice-over or a bit of simple music.

Remember one thing as you go about adding the final touches to your Perfect PC: Have fun.

The attractive, 0.7-pound external unit, which should find more than a few fans among laptop users for both its small size and its ability to connect to a PC via a standard parallel port, plays and records Windows waveforms (.WAV files) via its integrated microphone and speaker. An input jack allows recording from sources other than the microphone, while an output jack can be used to connect a set of headphones or to feed the output to speakers or another audio component. You won't get hi-fi audio from this product; hi-fi audio requires a true 16-bit, 44-kHz recording sampling rate, which gives you over 64,000 voices. Instead, the AudioMan provides an 8-bit, 11-kHz monaural recording sampling rate and only 256 voices, making it suitable primarily for voice recordings, and the unit doesn't offer stereo capability—but this may be enough for most business users.

A similar offering by Digispeech (415-494-8086), the $198.95 Digispeech Port-Able Sound Plus, offers many of the same capabilities and also connects to the host system via the parallel port. Where it differs from the AudioMan is in its recording capability: The Port-Able Plus has 16-bit recording and playback, and is compatible with Sound Blaster and Ad Lib.

The $289 Microsoft Windows Sound System, based on a 16-bit adapter, provides many of the same capabilities as the Digispeech offering, including Ad-Lib and SoundBlaster compatibility for use with games, 16-bit recording, and playback of .WAV files (see *PC Magazine*, April 27, 1993). In addition, it offers Adaptive Differential Pulse Code Modulation (ADPCM) compression and decompression of .WAV files, and the ability to play MIDI (Musical Instrument Digital Interface) files, though the board does not provide for connection of MIDI devices.

MIDI capability should be an important factor to anyone who needs to play or record more than an occasional snippet of music to be stored on disk. Unlike .WAV files, which contain the actual audio signals in megabyte-hungry, digitized form, MIDI files contain only code that tells a synthesizer what notes to reproduce and which instruments to use. An uncompressed, 16-bit, 44.1-kHz stereo waveform requires more than 10MB of disk storage for one minute of an audio program; compression might lower the required disk space to 2.5MB. The same one minute of audio might be stored in a MIDI file of about 15K. Many boards, though not the Windows Sound System, will accommodate a MIDI keyboard or other MIDI device through a built-in MIDI interface or have the ability to add one as an option.

Microsoft's business audio entry also offers a few nifty software utilities. Proof-Reader, for example, can read the contents of a spreadsheet to you, leaving your eyes free to check the numbers against printed copy. Voice Pilot provides limited voice-recognition capability, primarily as an aid in navigating the menus of Windows applications. As its name might suggest, the Microsoft Windows Sound System was designed for Windows 3.1 but can be run from DOS as well.

FUN AND GAMES

Of course, most PC audio products pursue a wider market and at least purport to offer the features that most people shopping for a sound board would care to have. The $250 CompuAdd Spectrum 16 Multimedia Sound Card, by CompuAdd Computer Corp. (800-627-1967), and its twin offering from Media Vision (800-845-5870), the $299 Media Vision Pro AudioSpectrum 16, both earned *PC Magazine* Editors' Choice recognition for achieving this ambitious goal better than the majority of their peers.

Like the Microsoft Windows Sound System, these two offerings allow stereo waveform recording and playback at 16-bit sampling rates of as high as 44.1 kHz—the same rates used in audio CD recordings—and they both support ADPCM compression and decompression. Both packages also provide Ad-Lib and SoundBlaster compatibility and incorporate the capable Yamaha OPL3 chip for FM synthesis, as does the Windows Sound System.

The offerings from CompuAdd and MediaVision surpass the Microsoft Windows Sound System in several regards, including their substantially better sound quality, as measured by PC Magazine Labs; their accommodation of an external MIDI device through an optional $69 MIDI/joystick adapter; their internal SCSI interface for attachment of a CD-ROM drive; and their ability to accept and mix audio from several inputs, including a digital input from a CD-ROM drive. Unlike the Windows Sound System, these two products also come with utilities both for Windows and for DOS, including Voyetra Technologies' MIDI Sequencer Plus Jr.

Another PC Magazine Editors' Choice winner—the Turtle Beach MultiSound—stood alone during the *PC Magazine* sound board roundup of April 27, 1993, as the only product to consistently produce the quality of audio you'd expect from an audio CD player.

This offering from Turtle Beach Systems (717-843-6917) achieves its audiophile-pleasing performance in part by employing a different type of synthesizer than that used by most of its competitors. Instead of generating simulations of the sounds of each musical instrument through frequency modulation (FM), as do FM synthesizers, this different type of synthesizer calls upon recorded samples of actual musical instruments, which are

stored in ROM, when it needs to produce the sounds of a particular instrument. The results are far more convincing than those of FM synthesizers. While several other boards included in the recent *PC Magazine* roundup employed wavetable synthesis, the Turtle Beach offering was the only one based on the excellent E-mu Systems Proteus 1XR chip.

As with all other sound boards, however, the Turtle Beach MultiSound isn't for everybody, particularly with its $599 suggested list price. Other drawbacks for some users include its lack of SCSI interface and microphone input—both omitted to keep electrical noise to a minimum—although both of these problems can be circumvented easily enough by spending a little more money. MultiSound also omits both Ad-Lib and SoundBlaster compatibility. MultiSound will accept audio signals from a CD-ROM drive once you purchase a SCSI interface card, and the sound board's line-level input will accommodate a line microphone, although these are more expensive than standard microphones. Turtle Beach's board is for those who value sound quality above all else, including the ability to coax sound effects from action adventure games.

Sooner or later, those shopping for an audio board are bound to wonder how important MPC (Multimedia PC) compliance is. The answer? Not very, particularly since Microsoft—the initiator and propelling force behind the MPC movement—began selling an audio board that didn't meet the specification. The Microsoft Windows Sound System leaves out the necessary joystick and MIDI connections and the ability to accept audio input from a CD-ROM drive.

If your primary goal is to compose music, make sure you get a board with a MIDI interface or a connector for one, and a board supported by the software you plan to use. If your just need to hear the sound effects of games, make sure you buy a board that provides Ad-Lib and SoundBlaster compatibility. In other words, narrow the field of offerings first to the products that will best meet your primary needs. Once you've done that, you can feel free to pick and choose between the additional features that seem most attractive to you.

DECISIONS, DECISIONS

Whatever your tastes in keyboards, your preferences in alternate input devices, and your yearnings for sound, make sure to remember one thing as you go about adding the final touches to your perfect PC: Have fun. You will find real differences among the products in all three categories that are discussed here, and you will certainly find some products that you like more than others. When agonizing over the myriad of details that can be considered when buying a PC, an individual can get to the point of diminishing returns relatively quickly—about as quickly as technologies tend to change.

Once you've done your reading and have determined your needs, make the best choice you can—before the process gets frustrating—and then don't look back. After all, the Perfect PC might in the end only be a state of mind—if a somewhat elusive one. □

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Movin' On Up: Hard Disk Upgrades

If you're feeling the storage squeeze, try adding an IDE hard disk for solid performance and easy installation at a price that won't break your bank.

THE FIRST STEP

Choosing the Right Drive

Modern computing being what it is, you're probably running out of storage space. If you're seeking an easy-to-install hard disk (as a replacement or additional unit) at the lowest price, the drive of choice is unquestionably an IDE (integrated drive electronics) drive.

According to International Data Corp., IDE drives accounted for around 60 percent of all 1992 hard disk shipments in the 100MB to 300MB capacity range, with SCSI (small computer system interface) drives making up most of the remaining sales.

The appeal of IDE drives comes, in part, from the fact that they integrate the controller functions into the disk assembly, though they require a simple interface card or an interface built into the system motherboard. In comparison, older ST-506 drives depend on a separate drive controller to process the data read from the disk and then pass it on through the bus. SCSI drives also use an integrated controller but must be connected to a SCSI host adapter, adding installation and compatibility problems. IDE drives avoid these drawbacks by conforming to the AT bus.

The integration of controller functions into IDE drives also lets manufacturers boost the capacity of storage per platter over ST-506 capabilities. The ST-506 controller forces a drive to store an identical number of sectors on each circular track of a platter,

by Mitt Jones

Photography by Mark Weiss

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USA Flex

whether the track is a short one near the center of the platter or a long one near the outer edge; this leaves a substantial portion of each platter unused. The ST-506 controller also dictates the method of encoding data and, indirectly, the platters' spin rate.

The IDE interface liberates manufacturers from such constraints. Given the freedom to store data more efficiently on each platter, for instance, manufacturers have reduced the size and number of platters needed to hold a given amount of data. Today, one 3.5-inch platter holds up to 210MB of data, though most 200MB hard disks use two platters. This drop in the number of platters needed, which also reduces the number of read/write heads needed, has in turn lowered drive size, cost (another important appeal), and power requirements, and has contributed to the performance increase.

Today, IDE offerings come in capacities of up to 1GB (though the 3.5- by 1-inch design we tested tops out near 420MB) and boast maximum throughput rates ranging from 3MB per second to 4MB per second. (In comparison, ST-506 drives generally manage less than 1MB per second.) But if you're seeking capacities above 1GB or need throughput of 10MB per second or more, you'll want to investigate SCSI drives. For a more thorough debate of IDE versus SCSI, see "The Perfect Hard Disk" in this issue.

REVIEW CRITERIA

To arrive at the list of 14 drives we tested, we asked major hard disk manufacturers to provide an IDE drive in every capacity ranging from 100MB to, but not including, 400MB. In addition, we specified that the drives must be of the popular 3.5- by 1-inch design.

Each of five vendors—Conner Peripherals, Maxtor Corp., Quantum Corp., Seagate Technology, and Western Digital Corp.—sent at least one drive in the 200MB and 250MB classes, for a total of eight units. We also tested the 245MB Quantum Hardcard EZ 240, an add-in card that builds on the drive used in Quantum's standard IDE offerings. The three drives in the 100MB class came from Quantum and Western Digital. Seagate and Western Digital each provided one 340MB drive. Maxtor was unable to deliver its 340MB offering in time for testing. Fujitsu Computer Products of America2 and Zentek Storage of America also could not deliver drives in time.

All of the drives we tested should prove reliable and fast enough for all but the most demanding users. Keep a few points in mind when making your decision, however. First, the formatted capacities quoted by manufacturers depend on a definition of a megabyte as 1,000,000 bytes. As far as the CMOS (complementary metal-oxide semiconductor) code of your system is concerned, however, a megabyte comprises 1,048,576 bytes. So don't be surprised when your CMOS setup utility reports the size of your new 250MB drive, say, as 238MB.

Second, drive makers now quote mechanical drive speed as *average seek time,*

HIGHLIGHTS

Hard Disk Upgrades

FOR THOSE SEEKING a quick boost in storage capacity, IDE (Integrated Drive Electronics) drives are attractive options, offering reliable performance and easy installation as well. For the first section of this story, we tested 14 IDE drives with capacities ranging from 127MB to 341MB. For the second section, we looked at 12 hard disk vendors and found that buying a second IDE drive is also fairly painless.

THE GREATEST THROUGHPUT on our DOS Disk tests came from drives using segmented look-ahead buffers. The 340MB Seagate ST3390A led the pack with 49.55K per second.

ADAPTIVE BUFFERING LETS a drive adjust the number and size of buffer segments when logic on the disk determines that doing so may increase the buffer hit rate.

WITH SPECIFICATIONS such as burst throughput and spin rate, higher is generally better. But in some cases, other factors compensate for the lower specification. Drives with relatively slow spin rates, for example, may also have electronics that enable data to be stored on-disk and/or retrieved more efficiently, as with the Western Digital models we looked at for this roundup.

THE BEST SOURCES FOR LOW prices are usually mail-order houses; you can find a 250MB hard disk for roughly $330 to more than $400 through this channel, though your system manufacturer may have a good deal as well. Most hard disk vendors don't sell direct in small quantities. If you're a novice, you should look for a vendor that provides solid technical support; otherwise, simply shop around for the best price.

250MB drives with a throughput score of 40.55K per second; the Seagate ST3283A came in a close second with an average score of 39.53K per second. When purchasing the Conner offering, make sure to get the version with the microcode that matches your system: The Conner Filepro 250 CP-30254-1 is designed for use in Compaq systems; the otherwise identical CP-30254 works with non-Compaq systems.

THE RIGHT SOURCE

Buying a hard disk as an upgrade or replacement unit involves more than just choosing a hard disk, however; you also have to find the source with the best service and support—and the right price. Of the 13 vendors we tested for service and support, Hard Drives International excels and is deserving of an Editors' Choice designation.

A constant source for low prices, HDI wins an Editors' Choice for its excellent service and technical support. Its kits were among the most complete we saw, and its detailed documentation will reassure even novices. But most importantly, our experience with HDI highlighted its technical support staff's extensive knowledge and technical competence. These qualities promise to make purchasing a drive from HDI painfree.

Conner Peripherals

Conner Filepro 250 CP-30254-1

The 251MB Conner Filepro 250 CP-30254-1 beat the throughput performance of all the 250MB-class, 3.5-inch IDE drives tested. The only question you may have when ordering this capable offering is precisely what version of the drive you should be getting.

Conner Peripherals initially submitted the 125MB Conner Filepro 125 CP-30124 and the Conner Filepro 250 CP-30254 for evaluation, but since neither contains the BIOS microcode needed to work with Compaq machines, neither would install properly on our Compaq Deskpro 486/33M test-bed. The Conner Filepro 250 CP-30254-1 that Conner subsequently provided matches the Conner Filepro 250 CP-30254 in basic design and specifications, but it contains the microcode that lets it work with the Compaq BIOS. Conner reports that the Conner Filepro 250 CP-30254 is compatible with the BIOS of all other major system manufacturers.

The generic version of the Filepro 250—the CP-30254—can vary in one detail: Conner specs the adaptive, segmented read/write look-ahead buffer at 32K but offers a boost to 64K as an option. Conner estimates that it ships about half of the drives with the larger buffer, which adds about $10 to the price.

FACT FILE

Conner Filepro 250 CP-30254-1

Conner Peripherals Inc., 3081 Zanker Rd., San Jose, CA 95134; 800-426-6637, 408-456-4500; fax, 408-456-4501

In short: This capable drive leads the pack of 250MB offerings in performance and carries a two-year warranty. But make sure you ask for the right version: The CP-30254-1 is designed for Compaq systems; the otherwise identical CP-30254 works with other PCs

470 ON READER SERVICE CARD

Equipped with an optional 64K buffer, the tested unit shared the lead in the 250MB category with the Seagate ST3283A. It managed an average throughput of 40.55K per second, with the Seagate following closely with a score of 39.53K per second. The Seagate packs a sizable buffer of 128K, but performance of both drives probably benefits less from buffer size and more from their exceptionally fast platter spin rates: 4,542 rpm for the Conner and 4,500 rpm for the Seagate.

Conner sells three other drives as part of the Filepro series, ranging from the 14-ms Conner Filepro 125 CP-30124 mentioned above to the 13-ms 343MB Conner Filepro 340 CP-30340. All Filepro drives carry two-year warranties.

The Conner Filepro 250 CP-30254-1 was the fastest in the 250MB class and comes from a company with a reputation for quality. If you opt for this drive, make sure you buy the version with the optional 64K cache.

Maxtor Corp.

Maxtor 7213A
Maxtor 7245A

If past hard disk offerings from Maxtor Corp. are any indication, the 213MB Maxtor 7213A and 246MB Maxtor 7245A will prove themselves reliable additions to many a storage-hungry PC. But users who demand the fastest performance will have to look elsewhere, at least for the time being.

Each drive carries an average seek time rating of 15 ms, spins its platters at a rate of 3,551 rpm, and uses a straightforward, 64K look-ahead buffer. Maxtor reports that a firmware change will add write-buffering capabilities to the Maxtor 7245A; they expect it to be ready by the time you read this.

Both of the Maxtor offerings we tested performed poorly compared with the fastest of their peers during our throughput tests. The Maxtor 7213A matched the performance of the 214MB Seagate ST3243A, but both the Maxtor 7213A and the 214MB Seagate managed only about 80 percent the tested throughput of the 213MB Western Digital Caviar WDAC2200.

FACT FILE

Maxtor 7213A

Maxtor 7245A

Maxtor Corp., 211 River Oaks Pkwy., San Jose, CA 95134; 800-262-9867, 408-432-1700; fax, 408-432-4510

In short: The 213MB Maxtor 7213A and the 246MB Maxtor 7245A will get the job done, but they fail to distinguish themselves when it comes to features or performance

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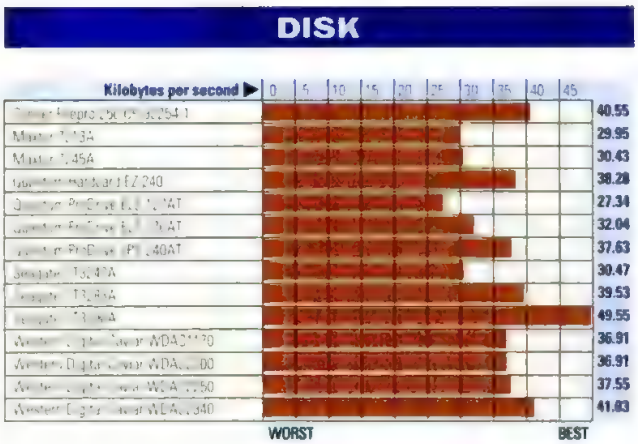
The Maxtor 7245A fared worse relative to its like-size competition, perform-

Benchmark Tests: Hard Disk Upgrades

The differences in throughput among the 14 tested drives were fairly slim, with 6 of the 9 drives in the 200MB to 250MB range performing within 7 percent of each other. Expect to see these performance margins shrink if you use a software cache with your hard disk.



What the Numbers Mean

The leader of the pack in throughput was the 340MB Seagate ST3390A. Equipped with a segmented look-ahead buffer, it turned in a disk score of 49.55K per second on our tests.

Drives using straightforward look-ahead buffers delivered average performance of no more than 32K per second. In comparison, the slowest drives with segmented look-ahead buffers, the Western Digital Caviar WDAC1170 and the Western Digial Caviar WDAC2200, clocked in at nearly 37K per second. (Keep in mind that our disk tests are performed without software caches enabled.)

Look-ahead buffers and segmented look-ahead buffers both use the same general approach: They read additional data ahead of the data currently being requested and store it in fast buffer RAM. Segmented buffers divide the total amount of buffer RAM—typically 64K—into smaller buffers so that data from more than one read can be stored at a time.

A further twist—adaptive buffering—allows a drive to adjust the number and size of the buffer segments when logic on the disk determines that the buffer hit rate can be increased by doing so. Half of the drives we looked at use adaptive buffering.

A larger buffer does not always guarantee better performance; other factors also have an impact on speed. It is no coincidence, however, that the fastest drive reviewed here, the Seagate ST3390A, came with a 256K buffer.

How We Tested

We tested the hard disks using a Compaq Deskpro 486/33M EISA equipped with an integrated Compaq IDE drive interface and 8MB of RAM.

The DOS **disk** score measures throughput using standard DOS INT 21h file I/O calls. The score is derived from a series of tests that measure the speed of file reading and writing, both sequentially and randomly; file sizes range from 256K to 32MB. The tests are performed without software disk caches installed.

ing significantly slower than any of the its competitors in the 250MB class and at about 75 percent the rate of the fastest in the bunch (the 245MB Seagate ST3283A).

The 7213A and 7245A each come with a one-year, renewable warranty; if either drive fails within the warranty period, the warranty begins fresh with the replacement drive.

Maxtor announced two new additions to its 7000 series of 3.5-inch, IDE drives as this project was drawing to a close. The Maxtor 7345A offers a 345MB formatted capacity, and the Maxtor 7131A packs 131MB of storage onto a single platter. Both drives use 64K look-ahead buffers and carry an average seek time rating of 14 ms.

When it comes to performance, the Maxtor 7213A and 7245A seem a bit lacking, particularly when compared with some of their peers. If you find an exceptionally good price on one of these drives, however, either one will do the job adequately.

Quantum Corp.

Quantum Hardcard EZ 240
Quantum ProDrive ELS 127AT
Quantum ProDrive ELS 170AT
Quantum ProDrive LPS 240AT

These four Quantum offerings manage, for the most part, to hold their own performance wise; the Hardcard EZ 240 promises to avoid the compatibility problems that owners of older systems may have when trying to add an IDE drive.

Quantum rates the two drives in the ELS series—the 127MB ELS 127AT and the 170MB ELS 170AT—at an average seek time of 17 ms. Both spin their platters at 3,663 rpm and utilize a 32K look-ahead buffer for read operations.

The 245MB LPS 240AT carries an average seek time rating of 16 ms, spins its platters at 4,306 rpm, and comes with a segmented read/write look-ahead buffer of 256K. The 245MB Quantum Hardcard EZ 240 is based on the same drive design as the LPS 240AT and shares most of its specifications.

The ELS 127AT turned in the lowest throughput score of all drives reviewed here, clocking in at 27.34K per second, but it also stands alone at the low-price and low-capacity end of the represented spectrum. The ELS 170AT improved substantially on the throughput of its less capacious sibling, averaging 32.04K per second. This figure is below the 36.91K per second rating of the like-size Western Digital Caviar WDAC1170 but above the nearly 30K per second throughput

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▶ SUMMARY OF FEATURES

Hard Disk Upgrades

Products listed in alphabetical order ■ = YES □ = NO	Conner Filepro 250 CP-30254-1	Maxtor 7213A	Maxtor 7245A	Quantum Hardcard EZ 240	Quantum ProDrive ELS 127AT	Quantum ProDrive ELS 170AT
Formatted capacity	251MB	213MB	246MB	245MB	127MB	170MB
Size (WxH, inches)	3.5 x 1	3.5 x 1	3.5 x 1	3.5 x 4.5	3.5 x 1	3.5 x 1
Average seek time (milliseconds)	14	15	15	16	17	17
Average access time (milliseconds)	21	23	23	23	25	25
Average rotational latency (milliseconds)	6.7	8.45	8.45	7	8.2	8.2
Revolutions per minute	4,542	3,551	3,551	4,306	3,663	3,663
Maximum data transfer rate (megabytes per second)	3	2.83	2.83	1.4	2.5	2.5
Burst throughput (megabytes per second)	9	9	9	5	4	4
Number of platters	2	2	2	2	2	2
Maximum power consumption at spin-up (watts)	14.4	10.2	9.8	12	12	12
Mean time between failures (hours)	250,000	150,000	150,000	250,000	250,000	250,000
Cache						
Buffer type	Adaptive, segmented look-ahead; read/write	Look-ahead; read only	Look-ahead; read only	Segmented look-ahead; read/write	Look-ahead; read only	Look-ahead; read only
Size (kilobytes)	64	64	64	256	32	32
Customer Support						
Telephone numbers for technical support	800-426-6637, 408-456-4500	800-262-9867, 408-432-1700	800-262-9867, 408-432-1700	800-826-8022, 408-434-9262	800-826-8022	800-826-8022
Hours (eastern time)	10:00–8:00 M–F	8:00–8:00 M–F	8:00–8:00 M–F	10:00–8:00 M–F	10:00–8:00 M–F	10:00–8:00 M–F
BBS/fax-back document service	■ ■	■ ■	■ ■	■ □	■ □	■ □
Warranty (parts and labor)	2 years	1 year	1 year	2 years	2 years	2 years
Renewable	□	■ (parts)	■ (parts)	■	■	■

* Recorded information is available 24 hours a day, 7 days a week. All of the data in this table is taken from manufacturers' specifications.

achieved by the higher-capacity Maxtor offerings. Both 245MB offerings—the LPS 240AT and the Hardcard EZ 240—kept pace with the 256MB Western Digital drive and fell only slightly behind the 250MB units from Conner and Seagate.

FACT FILE

Quantum Hardcard EZ 240

Quantum ProDrive ELS 127AT

Quantum ProDrive ELS 170AT

Quantum ProDrive LPS 240AT

Quantum Corp., 500 McCarthy Blvd., Milpitas, CA 95035; 800-624-5545, 408-894-4000

In short: Of these four solid offerings, the 245MB Hardcard EZ 240 and the 245MB ProDrive LPS 240AT deserve the most consideration. Though more expensive than standard drives, the Hardcard offers advantages in compatibility that some buyers will find compelling.

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Quantum acquired the patents to the Hardcard design when it merged with Plus Development in 1991. Along with the 245MB model tested, the Hardcard series includes products in 42MB, 85MB, and 127MB capacities. Each can be bought through direct retailers and via mail order, and each comes with a reassuring guarantee: If any of them don't prove compatible with your 286-or-later AT-compatible system and any existing drives installed in it, you can obtain a full refund. Standard IDE drives, by contrast, may prove incompatible with some older systems—those with a system BIOS dated earlier than April 1990—and may require a special interface card to coexist in a system with ST-506 drives.

On the downside, setup for a Hardcard may require changing IRQ settings. And to use the full capacity of a Hardcard, you'll need a software driver (though the DOS driver occupied only about 5K during testing). Also, Hardcards are expensive compared with their IDE counterparts; the Hardcard EZ 240 lists at $689 (about $520 via mail order). The other 250MB drives tested sell for about $400, with installation hardware.

Any of these Quantum drives are a good bet as a first or second drive. The ProDrive LPS 240AT and Hardcard EZ 240 rank among the top in speed among drives of their capacity, with the latter offering simple installation of an upgrade drive, albeit at a relatively steep price.

Seagate Technology

Seagate ST3243A
Seagate ST3283A
Seagate ST3390A

First things first: The Seagate ST3243A isn't a 243MB drive; it's a 214MB drive. The Seagate ST3283A isn't a 283MB drive; its a 245MB drive. And the Seagate ST3390A is, well, a 340MB drive. Unlike its four competitors reviewed here, Seagate Technology integrates unformatted capacities into its model numbers instead of formatted capacities. The good news

Hard Disk Upgrades

	Quantum ProDrive LPS 240AT	Seagate ST3243A	Seagate ST3283A	Seagate ST3390A	Western Digital Caviar WDAC1170	Western Digital Caviar WDAC2200	Western Digital Caviar WDAC2250	Western Digital Caviar WDAC2340
				EDITORS' CHOICE			EDITORS' CHOICE	
	245MB	214MB	245MB	340MB	171MB	213MB	256MB	341MB
	3.5 x 1	3.5 x 1	3.5 x 1	3.5 x 1	3.5 x 1	3.5 x 1	3.5 x 1	3.5 x 1
	16	16	12	12	13	14	13	13
	21	24	19	19	22	22	22	22
	5	7.87	6.67	6.67	9	8.21	9	9
	4,306	3,811	4,500	4,500	3,322	3,652	3,322	3,322
	3.8	2.8	3	4.5	3.75	1.95	3.75	3.75
	5	5	6	6	5.75	5	5.75	5.75
	2	2	3	2	1	2	2	2
	10.8	12	18	22.8	12	10.5	12	12
	250,000	150,000	200,000	250,000	250,000	100,000	250,000	250,000
	Segmented look-ahead; read/write	Look-ahead, read only	Adaptive, segmented look-ahead; read/write	Adaptive, segmented look-ahead; read/write	Adaptive, segmented look-ahead; read/write	Adaptive, segmented look-ahead; read only	Adaptive, segmented look-ahead; read/write	Adaptive, segmented look-ahead; read/write
	256	32	128	256	64	64	64	128
	800-826-8022	408-438-8222	408-438-8222	408-438-8222	800-832-4778, 714-932-4900	800-832-4778, 714-932-4900	800-832-4778, 714-932-4900	800-832-4778, 714-932-4900
	10:00–8:00 M–F	11:00–8:00 M–F *	11:00–8:00 M–F *	11:00–8:00 M–F *	11:00–8:00 M–F	11:00–8:00 M–F	11:00–8:00 M–F	11:00–8:00 M–F
	■ □	■ ■	■ ■	■ ■	■ □	■ □	■ □	■ □
	2 years	1 year	1 year	1 year	3 years	3 years	3 years	3 years
	■	□	□	□	□	□	□	□

FACT FILE

Seagate ST3243A

Seagate ST3283A

Seagate ST3390A

Seagate Technology, 920 Disc Dr., Scotts Valley, CA 95066; 408-438-6550; fax, 408-429-6356

In short: The 340MB Seagate ST3390A gains notice by easily outperforming all of the other IDE drives we reviewed for this roundup. The slightly smaller and slightly slower 245MB ST3283A shares with the Conner drive top speed honors among drives in their capacity class

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is that the two higher-capacity versions of these drives rank among the fastest, most capable IDE drives available.

Seagate rates the average seek time of the ST3243A at an unspectacular 16 ms. The drive has a 3,811-rpm spin rate and uses a straightforward, 32K look-ahead buffer for read operations.

The faster, higher-capacity offerings—the ST3283A and ST3390A—each carry an impressive 12-ms average seek time rating and an equally impressive 4,500-rpm spin rate. Both make use of write caching and adaptive, segmented, look-ahead read buffering, but the ST3283A uses a 128K buffer and the ST3390A a 256K buffer.

The ST3243A turned in mediocre performance on our throughput tests. The ST3283A, however, came in a strong second in the 250MB class—following the Conner Peripherals drive—with an average throughput of 39.53K per second. The Seagate ST3390A left all other drives far behind, turning in a spectacular average throughput of 49.55K per second.

The Seagate ST3390A should easily win the hearts of those seeking top performance in a 340MB IDE drive. The Seagate ST3283A matches the performance of the fastest drives in the 250MB class, making it an attractive alternative.

Western Digital Corp.

Western Digital Caviar WDAC1170
Western Digital Caviar WDAC2200
Western Digital Caviar WDAC2250
Western Digital Caviar WDAC2340

All four Western Digital drives zip along at respectable rates and offer one thing their competition lacks: a three-year warranty.

Western Digital rates the Caviar WDAC2200 at an average seek time of 14 ms. This 213MB disk has a 3,652-rpm spin rate and a 64K adaptive, segmented look-ahead buffer (read only). The Caviar WDAC1170, WDAC2250, and WDAC2340 have average seek time ratings of 13 ms and spin rates of 3,322 rpm, and add write buffering to their adaptive, segmented look-ahead buffers. The 171MB WDAC1170 and 256MB WDAC2250 can hold a 32K or 64K

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buffer, but most ship with 64K. The 341MB WDAC2340 can hold either 128K or 256K of buffer RAM.

Throughput performance ranged from 36.91K per second for the WDAC1170 and WDAC2200 to 41.03K per second for the WDAC2340. This showing earned the WDAC1170 and WDAC2200 the top-ranking speeds in their capacity classes but left the WDAC2340 looking sluggish compared with the speedy 340MB Seagate drive. The WDAC2250 clocked in at 37.55K per second, not quite as fast as the 250MB Conner and Seagate drives.

FACT FILE

Western Digital Caviar WDAC1170

Western Digital Caviar WDAC2200

Western Digital Caviar WDAC2250

Western Digital Caviar WDAC2340

Western Digital Corp., 8105 Irvine Center Dr., Irvine, CA 92718; 714-932-4900

In short: Three of these drives landed near the top of the speed range in their respective capacities. The exception, the 341MB WDAC2340, performed respectably but couldn't catch the 340MB Seagate ST3390A.

474 ON READER SERVICE CARD

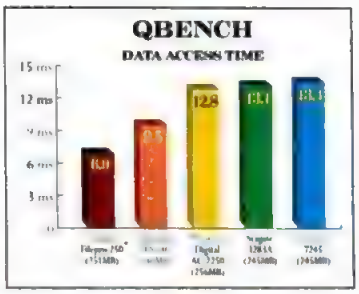
All four Western Digital drives reviewed here zip along at respectable rates.

Western Digital's three-year warranty only makes the top-ranked performance of the WDAC1170 and WDAC2200 drives all that much harder to resist. The 256MB Caviar WDAC2250 doesn't quite match the fastest of its 250MB competition, but the same three-year warranty adds strong appeal.

FILEPRO 250 UPSTAGES THE COMPETITION.

It's no act. The Filepro 250 is the fastest disk drive in its class. We took on the other disk drives in head-to-head performance tests, and came out as the star of the show.

For instance, the QBENCH benchmark revealed Filepro 250 outperformed other drives by 25 to 50 percent. PC Labs' benchmark showed Filepro 250 to be 30 to 60 percent faster in DOS file access time than any other 250MB class drive tested. And in the Windows™ environment, the Winbench v3.1 trials named Filepro 250 the overall performance leader by up to a 21 percent margin. Other benchmark programs tell the same, dramatic story.



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Conner Peripherals conducted all performance tests reported in this ad using publicly available benchmark programs on high performance, 486-based systems.

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CIRCLE 224 ON READER SERVICE CARD

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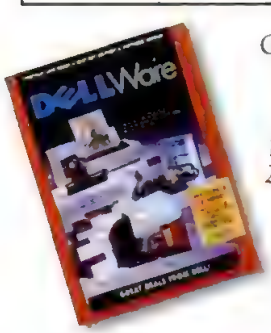

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THE SECOND STEP

Making the Buy

by Greg Pastrick

After you've narrowed your search for a storage-boosting IDE drive, you still need to buy the drive and install it. But don't worry; even if you've never seen the inside of your PC before, adding a second hard disk won't be nearly as difficult or time consuming as you might imagine. We know, because we've done it—13 times.

To find out exactly what it takes to find and install a second hard disk, we surveyed a sampling of the prime sources for hard disks: direct-market mail-order companies, drive manufacturers, and system manufacturers. Without identifying ourselves as *PC Magazine*, we called and asked each company to recommend an IDE drive in the 200MB range to be used as a second drive; in the event of multiple recommendations (a common occurrence), we chose the least expensive unit. We used a Gateway 2000 4DX2-66V as our installation test-bed. Later, we called back the 13 participating companies with questions to test their technical support.

The results of our experiment? Expect to spend about a day making phone calls and a fraction of that time putting the drive in your system. What follows is a description of our experience and some advice for your upgrade quest. If you're fairly at ease with installing hardware, focus your search on price; if you've never seen the inside of your system before, concentrate on looking for top technical support and installation aids.

If you're fairly at ease with installing hardware, focus your search on price.

KNOW BEFORE YOU CALL

Before you pick up the phone, you should have some idea of what you want and need. This means knowing your system, its expansion features, and the basic specifications of the installed hard disk. Check the documentation that came with your PC or pop open the case. First, look at the installed hard disk. You'll need to know how the drive is hooked up to your system, and it's a good idea to know the drive's make, model, and capacity. (Check the system documentation, the system CMOS (complementary metal-oxide semiconductor) setup, or the drive's labeling.

Next, check the ribbon cable attached to the drive. Standard cabling has 40-pin connectors at either end of a wide flat ribbon running from the back of the drive to an interface on either the motherboard itself or an interface card plugged into an

Installing Your Second Hard Disk

by Greg Pastrick

Access to system setup menus normally involves a Ctrl-Alt key combination, an executable setup utility, or interruption of the boot-up (check your PC's documentation or call your vendor if in doubt). First, enable the Second Drive option. If your setup screen reads Not Installed (or a comparable phrase), the system won't recognize your new drive.

Then enter the correct parameters (found in the drive documentation or on the labeling of the disk). CMOS (complementary metal-oxide semiconductor) setups have lists of common drive types, but you must use only those parameters—such as cylinders, heads, sectors, and size—that apply to your drive; otherwise, your disk won't be recognized and may suffer damage.

Most hard disks come with a 3-pin set of jumpers, two of which reference the master and slave pin sets, commonly labeled MA and SL (your second drive is the slave to the installed drive, which is the master).

Many vendors ship drives jumped as master drives, under the assumption that they are to be used as replacement or upgrade units. To use your drive as a second unit, you must designate it as the slave. To do this, fit the tiny black plastic jumper block over the appropriate pin set. (Check the drive documentation to determine the right pin set.)

If jumper blocks are not included with your new drive (a common occurrence), look on your installed drive and pull the jumper block off the installed drive and jump the second drive as slave. Unjumped, your installed IDE boot drive will continue to be recognized by your system as the master drive. (If you find that your installed drive is currently unjumped, you don't need to jump it as master before adding the second drive.)

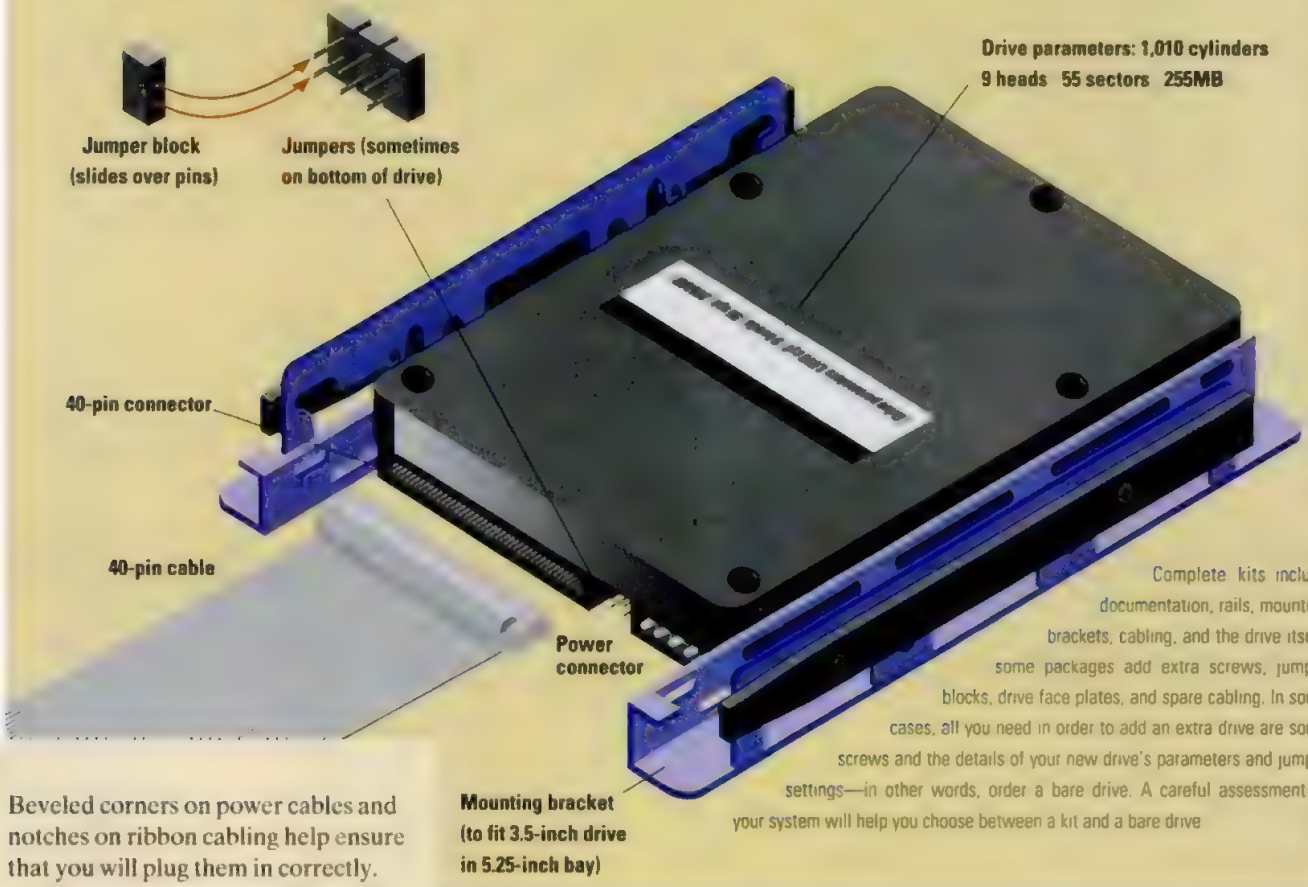
CABLING

If the standard 40-pin ribbon cable has an extra connector hanging off of it, use that for your second drive. (Check how your installed drive is connected before you unplug it.) Plug the same 40-pin connector and power cable back into the installed drive and use the extras for the second drive once it's in place in the drive bay.

If the existing cable doesn't have an extra connector and you've purchased a kit, use the cabling that accompanies the drive. Plug the top connector into the primary drive and the extra connector into the secondary drive. All modern ribbon cabling for IDE drives is straight through and doesn't require any twists. Whether the cable interface is on the motherboard or a paddle board, there's no need to disconnect the interface attachment at the other end to the ribbon cable, unless you're replacing the cable.

Installing Your Second Hard Disk

Whether you're installing a bare-bones drive or using a complete kit, adding a second IDE drive should be relatively easy, even if you're a novice. If disk installation fails, the problem is usually an incorrect CMOS setup entry, jumper setting, or cable connection.



Complete kits include documentation, rails, mounting brackets, cabling, and the drive itself; some packages add extra screws, jumper blocks, drive face plates, and spare cabling. In some cases, all you need in order to add an extra drive are some screws and the details of your new drive's parameters and jumper settings—in other words, order a bare drive. A careful assessment of your system will help you choose between a kit and a bare drive

Beveled corners on power cables and notches on ribbon cabling help ensure that you will plug them in correctly.

The last step is partitioning and formatting your drive. The low-level formatting on IDE drives is done in the factory. If your drive came with installation software, the program will handle system setup and disk preparation. If you're using DOS FDISK and FORMAT, make sure you use them on your new disk and not your installed drive.

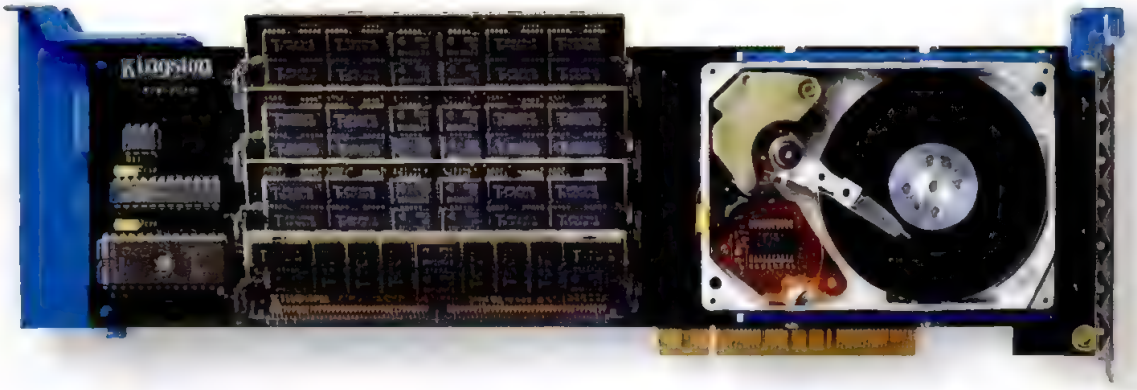
The FDISK main menu lets you select any fixed disks your system recognizes as being installed. Choose the Select Drive option from the menu, select the new drive (generally drive D: for a second drive) from the list, and follow the menu options to create a DOS partition for the entire drive. When finished, exit FDISK and format the drive by typing FORMAT D: (or whatever the appropriate letter might be).

expansion slot. You will typically find at least one extra connector hanging off the ribbon; our Gateway test-bed had two drive connectors on the motherboard. You should also see a 6-pin power connector plugged into the rear of your drive and at least three free power connectors running in a bundle off your system's power supply. Standard small-footprint AT and tower system designs provide power and interface connections for at least four to six internal devices, counting hard and floppy disks. Unless you're adding a third or fourth drive, chances are you won't need to buy an extra controller.

Next, size up the drive bay expansion space to determine what size drive you need. Most often, you will find both 3.5- and 5.25-inch horizontal bays. Some small-footprint systems come with vertical bays to save internal space; others have bays in which you can stack two drives in a single space. Some slimlines come with half-height bays.

Also note any mounting hardware already in place. This will tell you if you need a bare drive or a kit. Ordering a *bare drive* guarantees you only the drive, though our experience showed that you'll probably also get an instruction sheet and maybe a cable and rails. *Kits* often include instructions, cables, rails, mounting brackets, drive face plates, a package of screws, and sometimes installation soft-

Our Contributors: MITT JONES is a contributing editor to *PC Magazine*. GREG PASTRICK is a frequent contributor to *PC Magazine*. CATHERINE KUNKEMUELLER was the associate editor in charge of this story, and MICHAEL J. ZULICH was the project leader.



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CIRCLE 106 ON READER SERVICE CARD

Dealers' Pick: 300MB, 500MB, and CD-ROM drives

In addition to requesting recommendations for 200MB hard disks, we asked the hard disk vendors to recommend 300MB and 500MB hard disks, and CD-ROM drives. Recommendations were based on adding a second drive to a Gateway 2000 4DX2-66V with an installed 60MB drive. Suggestions reflect items in stock, and prices are as of May 3, 1993.

Companies listed alphabetically	Recommended 300MB hard disk	Recommended 500MB hard disk	Recommended CD-ROM drive
Computer Discount Warehouse	340MB Maxtor IDE drive ($589)	535MB Maxtor IDE drive ($929); 512MB Conner IDE drive ($949)	Toshiba 3401 SCSI CD-ROM drive ($709), Texel DM-5024 SCSI CD-ROM drive ($769)
Computer Products Corp.	341MB Seagate IDE drive ($484); 340MB Maxtor SCSI drive ($586, SCSI interface, $239)	452MB Seagate IDE drive ($614); 540MB Conner SCSI drive ($870; SCSI interface, $239)	Mitsumi proprietary CD-ROM drive ($189), Toshiba XM-3401 SCSI CD-ROM drive ($479, SCSI interface, $239)
Dirt Cheap Drives	340MB Western Digital IDE drive ($545)	520MB Fujitsu IDE drive ($879)	Creative Labs multimedia kit (with Matsushita SCSI CD-ROM drive, $535)
Gateway 2000	340MB Western Digital IDE drive ($445)	500MB Seagate SCSI drive ($800, SCSI interface, $215)	Sony 31A CD-ROM drive ($225 with proprietary SCSI interface)
Hard Drives International	340MB Western Digital IDE drive ($449)	510MB Fujitsu IDE drive ($849)	Talon TA1000 multimedia kit with Philips proprietary CD-ROM drive ($449), Talon TA2000 multimedia kit ($669 with NEC or Texel SCSI CD-ROM drive)
Megahaus	340MB Western Digital IDE drive ($559)	513MB Fujitsu IDE drive ($879)	Texel DM-3024 SCSI CD-ROM drive ($489 with SCSI interface)
PC Connection	N/A	500MB Conner IDE drive ($969)	CD-Technology CD Porta-Drive SCSI CD-ROM drive ($610, SCSI interface, $155), NEC CDR-74 SCSI CD-ROM drive ($629, SCSI interface, $79)
PC Zone	340MB Maxtor IDE drive ($698)	N/A	NEC CDR-74-1 SCSI CD-ROM drive ($692 with SCSI interface, $878 as part of multimedia kit)
Radio Shack/ Tandy Corp	340MB Western Digital IDE drive ($599)	N/A	Tandy CDR-1100 proprietary CD-ROM drive ($299 with proprietary SCSI interface)
Swan Technologies	340MB Western Digital IDE drive ($790)	500MB Conner IDE drive ($1,100)	Texel DM-3024 SCSI CD-ROM drive ($489 with SCSI interface)
Treasure Chest	340MB Maxtor IDE drive ($625)	513MB Fujitsu IDE drive ($889)	Texel DM-3024 SCSI CD-ROM drive ($409, SCSI interface, $80)
USA Flex	425MB Seagate IDE drive ($629)	600MB Seagate SCSI drive ($999, SCSI interface, $199)	Sony Laser Library CD-ROM drive ($399), NEC CDR-74 SCSI CD-ROM drive ($679)

N/A—Not applicable. The vendor does not sell a drive with this capacity.

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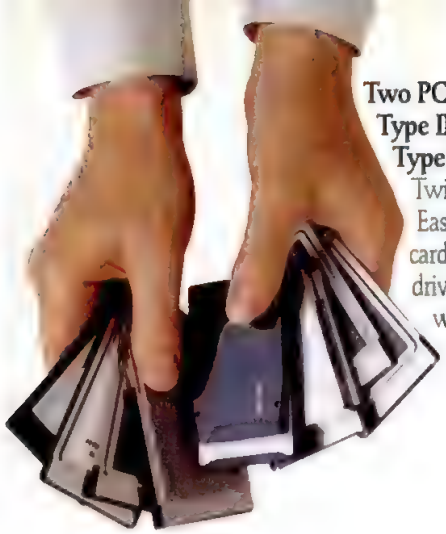
CIRCLE 399 ON READER SERVICE CARD



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LCD Status Bar: Delivers an instant read of the battery life remaining, power-saving mode, and a host of other key notebook settings.

Blazing 33MHz i486™SL: With built-in coprocessor support, delivers the ultimate in notebook processing power.

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- 9.5" color active matrix TFT-LCD screen
- 120/200/340MB HDD
- 6.9 lbs.
- NiMH battery

T4600

- 9.5" high-contrast, black and white LCD screen
- 120/200MB HDD
- 6.4 lbs.
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- Intel 486SL/ 33MHz, 3.3 volt processor with 8K cache
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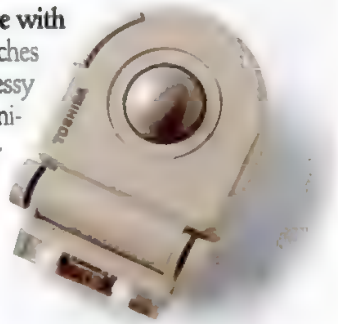
- Toshiba MaxTime™ Power Management system, and extensive 3.3v components provide industry-leading battery life.
- Pre-installed software: DOS 6.0, Windows® 3.1, and UltraFont.™

intel inside

Large 9.5" Color Active Matrix TFT-LCD Screen: This exceptional technology delivers spectacular color for vivid graphics and dazzling presentations.

BallPoint™ Mouse with QuickPort™: Attaches easily, without messy cords, for ergonomically ideal input—perfect for Windows® applications.



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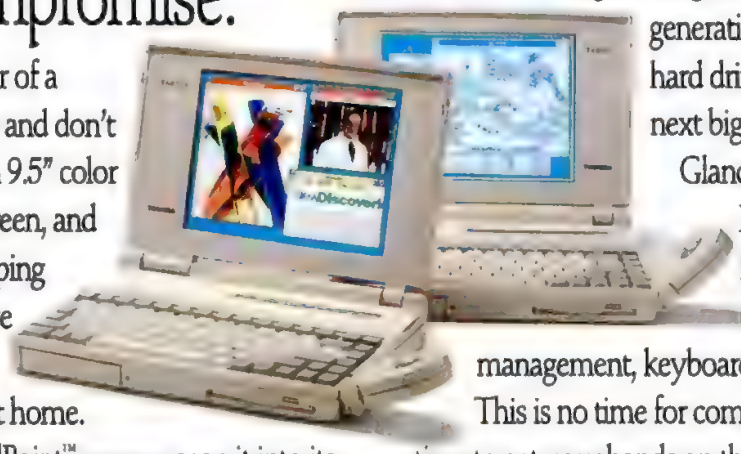

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CIRCLE 379 ON READER SERVICE CARD

▶ SUMMARY OF FEATURES

Hard Disk Upgrades

Companies listed in alphabetical order ■ = YES □ = NO	Computer Discount Warehouse	Computer Products Corp.	Dirt Cheap Drives	Gateway 2000	Hard Drives International	Megahaus
Address	2840 Maria Ave., Northbrook, IL 60062	1431 South Chemyvale Rd., Boulder, CO 80303	1110 NASA Rd. One, #304, Houston, TX 77058	610 Gateway Dr., North Sioux City, SD 57049-2000	1912 W. 4th. St., Tempe, AZ 85281	1110 NASA Rd. One, #306, Houston, TX 77058
Customer sales phone number	800-326-4239, 708-564-4900	800-338-4273	800-473-0923, 713-333-2099	800-846-2000, 605-232-2000	800-927-7848, 602-902-1176	800-786-1174
Customer sales fax number	708-291-1737	303-442-0501	713-333-3024	605-232-2023	602-350-1150	713-333-2033
Recommended 200MB drive	Maxtor 7213A	Maxtor 7245A	Maxtor 7213A	Western Digital Caviar WDAC2250	Western Digital Caviar WDAC2200	Conner CP-30204
Price (as of 5/3/93)	$289.95	$309.00	$315.00	$325.00	$289.00	$339.00
Shipping						
Overnight service available	■ (cost varies)	■ (cost varies)	■ ($28)	■ ($5)	■ (cost varies)	■ ($25)
Two-day delivery available	■ (cost varies)	■ (cost varies)	■ ($18)	■ (cost varies)	□	■ ($15)
Ground transportation available	■ (cost varies)	■ (cost varies)	■ ($8)	■ (cost varies)	□	■ ($9)
Dealer pays for return shipping	□	■	□	□	□	□
Replacement Service						
Customer returns to dealer	■ (within 15 days)	■	■	■	■	■
Customer returns to disk manufacturer	■	■	□	■	□	□
Average service turnaround	24 hours	24 hours	48 hours	24 hours	24 hours	48 hours
Technical Support						
Support hours (eastern time)	8:00–7:00 M–F, 9:00–5:00 Sat.	10:00–7:00 M–F	10:00–7:00 M–F	7:00 A.M.–1:00 A.M. M–F; 10:00–3:00 Sat.	24 hours, 7 days	10:00–7:00 M–F
Telephone support	Free	Free	Free	Free	Free	Free
800 number/toll number	□ ■	■ □	□ ■	■ ■	■ ■	□ ■
BBS/fax-back document service	■ ■	■ ■	□ □	■ ■	□ □	□ □
Warranty						
Duration	1 year	1 year	2 years	1 year	1 year	1 year
Extended warranty	None	None	None	None	1 year (9% of sales price)	None
Money-back guarantee	■	■	□	■	■	■
Return period	15 days	30 days	30 days	30 days	30 days	30 days
Restocking fee	15% of sales price	None	15% of sales price	None	None	None

ware. Most bays are bare, but if you already have rails to hold the new drive in place in the open bay, you won't need to buy more. Mounting brackets let you use a 3.5-inch drive in a 5.25-inch bay.

If you have a serious aversion to drive bays, consider one of Quantum Corp.'s Hardcards: a hard disk on a card that plugs into an open expansion slot on the motherboard. Quantum owns the patents to the Hardcard design and makes Hardcards in capacities ranging from 42MB to 245MB. For this issue, we looked at the 245MB Quantum Hardcard EZ 240. But easy installation comes at a price; the Hardcard EZ 240 usually costs $100 to $120 more than a regular 240MB IDE drive. (Quantum, 800-624-5545, is absent from our Summary of Features because the company does not sell directly to end users; the service and support policies will depend on your dealer.)

Finally, decide how big a drive you want. You will probably want to price drives that match or beat the capacity of your installed drive. In late April, the cost of drives with capacities of 170MB and above had generally fallen below $2 per megabyte; 250MB drives were available for less than $1.50 per megabyte.

To find the best buy on your second hard disk, you're going to have to make some calls. Try starting with the back pages of *PC Magazine* or one of the many publications devoted to direct-market sales. A direct-market supplier of hard disks is the obvious choice for the price-conscious consumer. Another option is buying from your system's vendor; this usually assures informed technical support and absolute warranty protection. Hard disk manufacturers generally don't sell direct for small quantities. Our survey is in no way comprehensive, but it does give you an idea of what to expect from these market channels.

During our preliminary calls (made the first week of March), we found com-

PC Connection	PC Zone	Radio Shack / Tandy Corp.	Swan Technologies	Treasure Chest	USA Flex
6 Mill St., Marlow, NH 03456	17411 N.E. Union Hill Rd., Redmond, WA 98052	1500 One Tandy Center, Ft. Worth, TX 76102	3075 Research Dr., State College, PA 16801	1310 Carroll St. Kenner, LA 70062	471 Brighton Dr., Bloomingdale, IL 60108
800-800-0005, 603-446-0005	800-258-2088, 206-883-3088	817-390-3011	800-468-9044, 814-234-2236	800-723-8282, 504-468-2113	800-444-4900
603 446 7791	206 881-3421	None	814-237-4450	504-461 8095	708 351 7204
Conner CP-30204	Maxtor 7213A	Tandy 240MB AT SmartDrive	Quantum ProDrive LPS 240AT	Western Digital Caviar WDAC2200	Seagate ST3283A
$349.00	$408.00	$699.00	$599.00	$299.00	$339.00
■ ($5)	■ ($6)	□	■ ($40)	■ ($10)	■ (cost varies)
□	■ (cost varies)	□	■ ($30)	■ (cost varies)	■ (cost varies)
□	■ $3)	□	■ ($18)	□	■ (cost varies)
□	□	■	□	□	□
■	■	■	■ (within one year)	□	■
□	□	□	■ (within second year)	■	□
24 hours	48 hours	48 hours	24 hours	48 hours	72 hours
9.00–9.00 M–F 9.00–5.30 Sat	10.00–9.00 M–F	9:30–6.30 M–F	9.00–9.00 M–F; 9:00–5.00 Sat., Sun.	8:30–8:00 M–F; 10:00–4:00 Sat.	24 hours, 7 days
Free	Free	$49.95 quarterly	Free	Free	Free
■ ■	■ ■	□ ■	■ □	■ □	■ ■
□ □	■ □	□ ■	■ □	■ □	■ ■
1 year	4 months	1 year	1 year	1 year	1 year
None	None	3 years ($149)	None	None	None
□	■	■	■	■	■
None	30 days	30 days	30 days	30 days	30 days
None	None	None	None	None	None

panies' recommendations for 200MB hard disks centered on two names: Maxtor Corp. and Western Digital Corp. Of 19 calls to mail-order vendors, seven vendors recommended the 213MB Maxtor 7213A, with quoted prices ranging from $297 (Computer Discount Warehouse) to $480 (CompUSA). Four suggested a 212MB Western Digital, three a 212MB Conner, and one apiece a 245MB Maxtor, a 250MB Western Digital, a 245MB Seagate, a 212MB Procom, and a 240MB Quantum. Radio Shack/Tandy Corp. quoted the highest price: $756.57 for a 240MB Quantum ProDrive LPS 240AT, labeled the Tandy AT SmartDrive.

By early May, however, prices on these same drives had changed; the low range had dropped to $289 (from Hard Drives International) and $289.95 (Computer Discount Warehouse), and the high end—still Radio Shack/Tandy—was down to $699. Don't be surprised if the favored brand or the pricing changes again before you make your calls; pricing specials are often based on the quantity of each drive the company has in stock.

For most mail-order companies, you'll find that general information and technical expertise in sales is limited to the products on sale or to the resources on the salesperson's desk. But all the companies we called provided clear responses to questions on warranty and return policies, as well as installation help.

If you're using a system whose architecture requires a specific drive (as do systems by Compaq Corp. and IBM Corp., for instance), be sure to let the salesperson know, as this may affect drive compatibility. Just don't expect the salespeople to ask for the information: The only vendors that asked for our system's specs were Dell Computer Corp. and Gateway 2000.

THE WAITING GAME

Once you've found the right drive at the right price, you face only the wait for your drive to arrive—and its installation. In our experiment, after we tallied the companies' recommendations, we called back as *PC Magazine* and requested the drives for review. Megahaus was the only company to deliver a substitute for the drive it originally recommended: The Conner Peripherals 212MB replacement ($339) offered comparable performance at a better price than the 212MB Maxtor drive the company had originally recommended. Several companies declined to send drives in for testing: Aplus Computer, ComputerLand, CompUSA, Dell, Lyco Computer, PC Zone, Quick Electronics, Storage Devices International, Radio Shack/Tandy, and Upgrades International. In two cases—when dealing with PC Zone and Radio Shack/Tandy—we bought the drives to round out our end-user experience.

The participating companies were asked to send their drives using the fastest delivery methods available that would get the drive to us within one week. And in fact, each company delivered the drives within four days, including those using standard ground carriers. The local Radio Shack outlet we dealt with even hand delivered the drive, though such service should not be expected. Many companies ship ordered drives according to customer preference; all use Federal Express or United Parcel Service ground and air services. Most shipping-and-handling charges add $10 to $20; expect more for overnight delivery.

When the drive arrives, review the invoice and act immediately if you find damage or discrepancies with your order.

While 30-day refund periods are common, some companies have shorter refundable time periods. Only one company in this roundup—PC Connection—has no return period and no money-back guarantee. Gateway 2000 allows a 30-day return period, while Computer Discount Warehouse has a 15-day return period but charges a restocking fee of 15 percent of the sales price.

INSTALLATION

If you ordered a kit instead of a bare drive, chances are you'll have all the hardware pieces you need, including screws to secure the drive in the bay. One essential piece you will need is the tiny, black, plastic jumper block. Look for it either on the drive itself or in a package with the kit's screws. Since most vendors ship these drives as replacement drives, jumper blocks aren't often provided, but you will need one to install a drive as an additional unit. Gateway 2000 and Hard Drives International (HDI) were the only vendors to provide loose, spare jumper blocks in their kits.

Only 4 of the 13 companies in this roundup included installation software, which is ultimately more a matter of preference than necessity. (You can use your system's setup along with DOS FDISK and formatting utilities for DOS-level formatting; installation software simply automates these tasks.) Dirt Cheap Drives and Megahaus sent MicroHouse EZ-Drive IDE drive installation software; PC Connection included Ontrack Disk Manager software. Quantum's Hardcard also came with automated installation software.

Another piece of software to look for—either from the hard disk vendor or elsewhere—is disk-doubling software. The enhanced compression in commercial disk-doubling software and in disk doubling included with DOS 6.0 lets you turn a 212MB drive into a 424MB storage device. HDI added Stac Electronic's Stacker, Version 2.0.

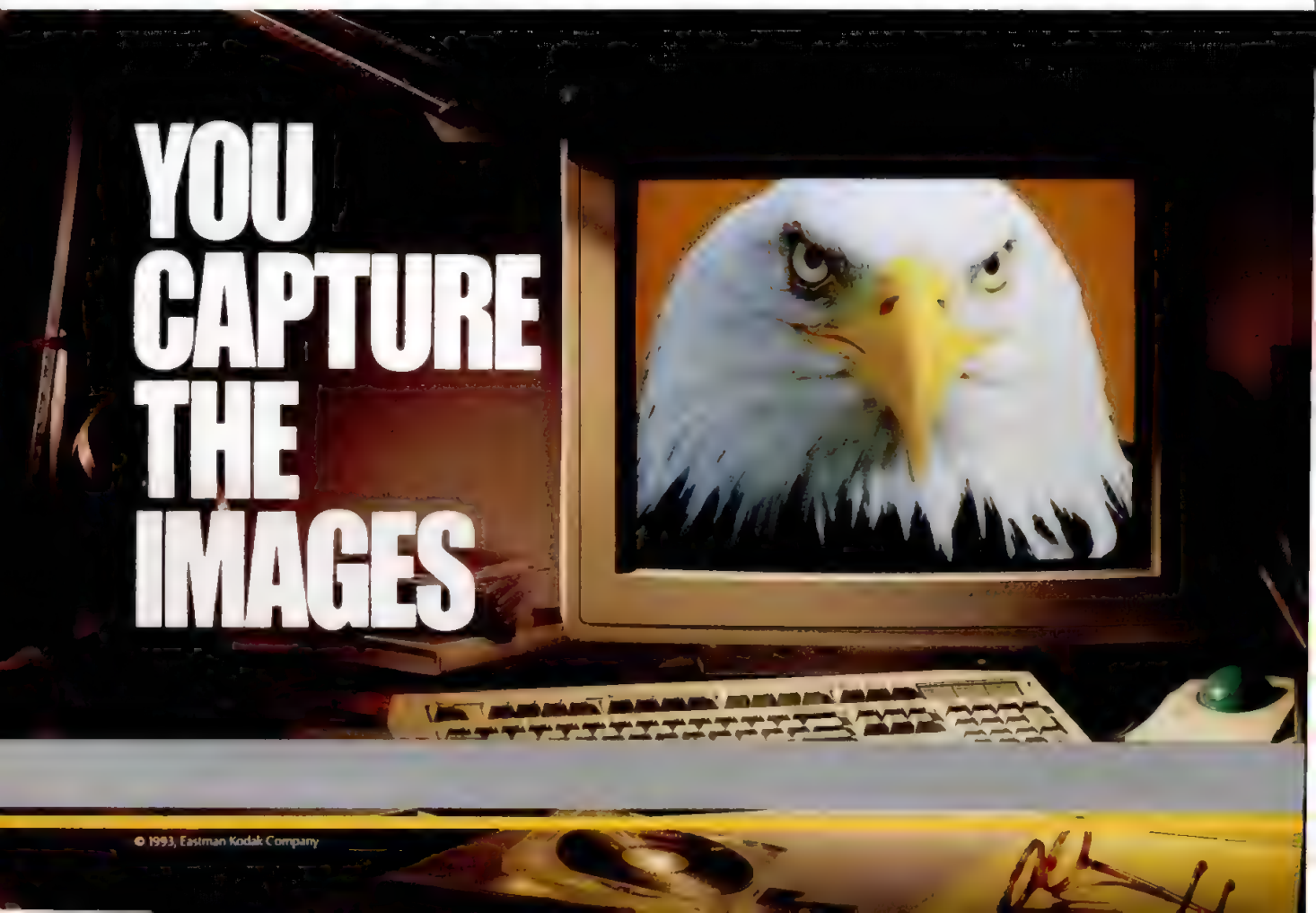
DOCUMENTATION

Documentation can be as little as a single sheet or as much as a full manual, but volume is less critical than quality. Minimally, you need the details of basic drive type parameters and jumper settings.

Gateway 2000 provides two full manuals: one devoted to hard disk–specific installation and the other to general device installations for their systems. HDI combines a detailed set of materials with good illustrations and information on a variety of drives and installations. Radio Shack/Tandy also includes a full manual. Treasure Chest supplied only two installation sheets for its $299 Western Digital Caviar WDAC2200—one on drive-rail attachment and one on drive installation. All the other vendors supplied adequate documentation, except Computer Discount Warehouse, which didn't send even the most basic instruction sheet.

You should also look for mounting-bracket installation instructions. Gateway 2000 took the trouble to send the drive premounted with the brackets.

Accessible and solid technical support can be more important than documentation, especially when you run into trouble. Although we had real installation



problems for only two of the tested drives, we called all of the vendors with questions that focused on correct system setup of drive type parameters, jumper settings for the slave drive, partitioning, and formatting; we did not identify ourselves as *PC Magazine*. In general, we found the technical support adequate enough to answer our basic questions.

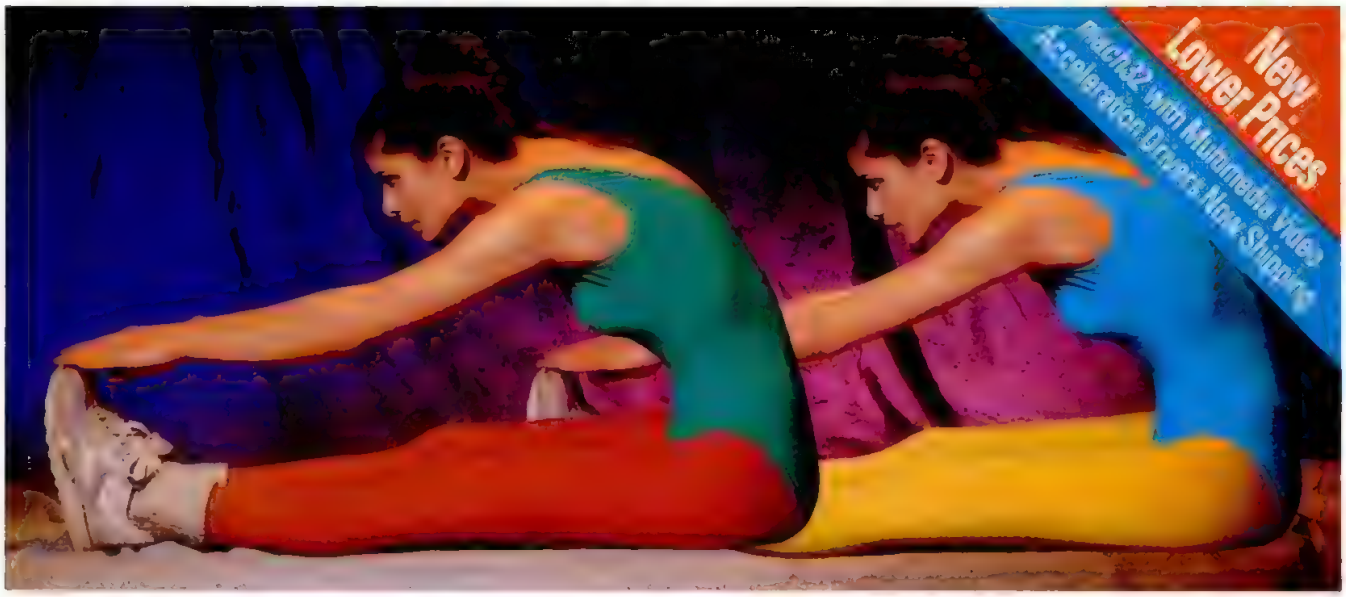
We did have some remarkable responses, however. PC Zone's technical support was unable to advise us on jumper settings; the USA Flex support line was unable to help us locate drive type information or partition and format the drive. Dirt Cheap Drives and PC Connection, however, were notable for their informed and effective responses. And for sheer determination, HDI and Quantum deserve special mention.

HDI's $289 Western Digital Caviar WDAC2200 arrived without physical signs of damage, but it eventually proved unusable. The support staff was knowledgeable and showed an uncommon level of technical competence. After guiding us through several attempts at configuring the drive as both a primary and secondary disk, their support person walked us through rewriting the partition information using DEBUG.EXE in a final effort to stop the drive from crashing DOS FDISK. When all failed, we were given a return authorization number; a working replacement arrived within a week.

If you have a serious aversion to drive bays, you might want to consider one of Quantum's Hardcards.

Quantum's value-added technical support service gave us equally determined and knowledgeable help when we ran into real installation trouble with the Hardcard EZ 240, trouble ultimately diagnosed as a BIOS I/O conflict with our Gateway 2000 test-bed. The Hardcard plugs into a free expansion slot on the motherboard, so that the only hardware to manipulate is a set of switches on the card; the switches fix the I/O address and IRQ for the card. Generally, the default settings work, but the automatic installation was unable to get our system to accurately recognize the Hardcard. After many attempts to help us install the Hardcard—some of which showed the device as having negative megabyte capacity—Quantum's support person isolated the correct switch settings and advised us on the appropriate address range exclusion to enter on the EMM386.EXE line in the CONFIG.SYS file.

For those who need the security of top technical support, documentation, and guided installations, most of these vendors will meet your requirements. (The fact that we experienced only 1 failed installation out of 13 should reassure users with any qualms.) With an IDE drive's reasonable price and easy installation, there is no reason not to go out and add megabytes to your system. □



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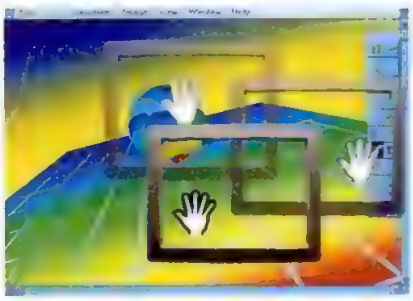

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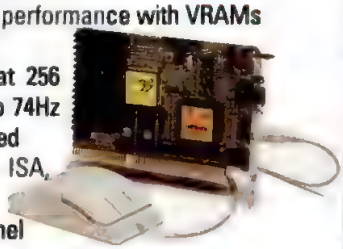

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HOW FAST IS FAST?

Video Cards Revisited

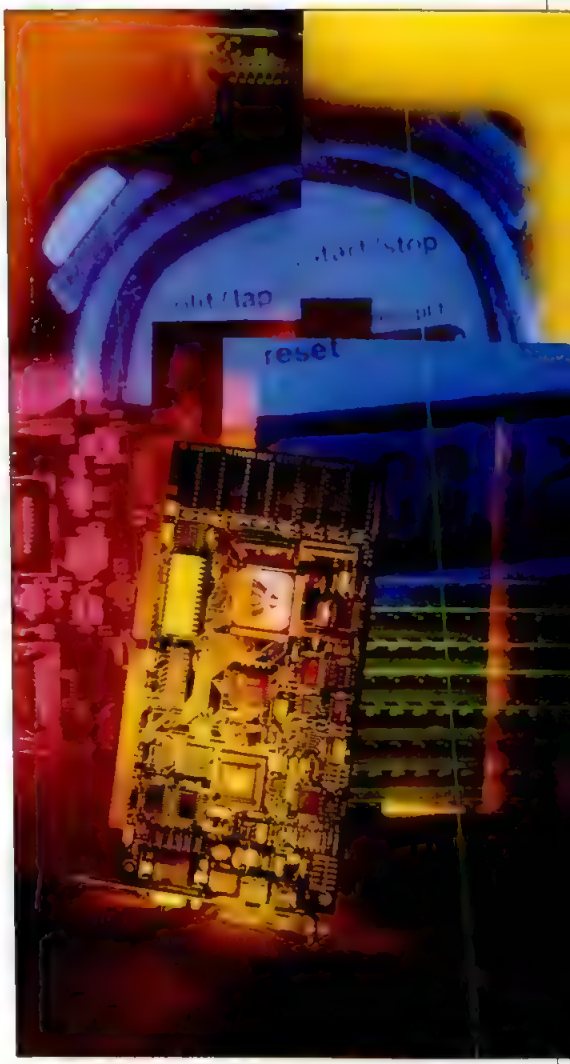
What video board should you buy? We look at how well the leading graphics accelerators perform under Windows.

by Ben Myers

During the last two years, graphics hardware has been one of the fastest changing areas of personal computing—and one of the most intensely competitive. The enormous popularity of Windows has created an unprecedented need for video cards that can handle the demands of graphical user interfaces (GUIs) and the programs that run in these environments. PC users are being confronted with graphical word processors, spreadsheets, databases, charting software, drawing programs, and image editors that demand higher resolutions and at least 256 colors. The traditional frame-buffer video cards that were just fine for text-based programs running under DOS are simply too slow for the new generation of software products.

If you want to pep up an existing machine to run Windows, one of the fastest and easiest ways to do it is to upgrade the graphics card. Choosing the right Windows accelerator card can mean a video speed boost to three to ten times the speed of a standard VGA card. It doesn't match the impact of a faster drive, a more powerful CPU or larger memory, but speedy video, especially in a graphical environment, can make it appear that your PC has had an injection of steroids.

Graphics vendors have fought fiercely for this new Windows market, where margins are slim and product life spans are short. The selling pitch of video card vendors has been higher resolution and higher speed with more colors. All the rapid improve-



IN THIS REVIEW

ATI Technologies Inc.
Cardinal Technologies Inc.
Diamond Computer Systems Inc.
Hercules Computer Technology Inc.
Metheus Corp.
National Design Inc.
Number Nine Computer Corp.
Orchid Technology Inc.

Photograph by Kathleen Fay

ments and innovations in technology are focused on making images on your monitor display faster, no matter how many more pixels and how many more colors are being manipulated. The promise is that Windows will snap, regardless of color depth and resolution.

Windows and Windows applications require software drivers matched specifically to the card that is controlling the monitor. To speed up the display, the graphics accelerator cards shift common graphics operations from the CPU to custom chips on the video card. (For a more detailed discussion of video card technology, see "The Perfect Display," part of our cover story in this issue.) Here too, the video driver becomes critical: How well will it shift graphics operations to the video card, and once they are there, how fast will they run? Some graphics card vendors have tried to differentiate themselves from their competitors by adding features such as zooming, panning, virtual desktops, or anti-aliased fonts. Some vendors tout the use of faster—and more expensive video RAM (VRAM)—chips for graphics memory instead of the usual dynamic RAM (DRAM). Inevitably, they come back to the one feature that consumers can easily understand: speed. And speed becomes quantifiable when performance under Windows is tested with *PC Magazine*'s Winbench benchmark test program.

There are two basic approaches to measuring a computer's performance: a synthetic benchmark, which uses repetitive operations to simulate work a computer would do, and an applications benchmark, which uses actual programs that users are likely to run. Winbench 3.11, a synthetic benchmark, isolates the major Windows graphics operations by running them repeatedly and measuring how much work each accomplishes in a given period of time. Based on an extensive analysis of graphics functions in market-leading Windows applications, Winbench weights the results of the most important graphics functions to produce a single-number rating of graphics card performance, the Graphics Winmark.

That single number has become a coveted marketing lever for the card vendors. Being able to proclaim that your card does 15, 30, or even 50 megapixels per second is a way of attracting attention in a crowded marketplace. In many cases, companies have focused their efforts on getting the highest Winmark scores they can. That's not necessarily bad. The problems begin when the optimization for the sake of Winmark scores doesn't benefit the applications you run.

How do vendors speed up video performance? Every graphics card has some memory that is *off-screen:* When pixels are placed in this off-screen memory, nothing happens on-screen. A graphics accelerator can copy a bitmap from off-screen memory to the visible on-screen memory far more quickly than the CPU can push pixels across the Industry Standard Architecture (ISA) bus. By caching to graphics memory, the driver can place objects most likely to be reused where they can be accessed most quickly: in the off-screen graphics memory.

To make the most effective use of caching, the drivers' designers have to answer a challenging set of questions. Which objects should they cache: icons, fonts, text characters, or other bitmaps? The wrong choices mean more overhead and more time managing the cache—and slower graphics performance.

Some companies realized they could crank up their scores in the Graphics Winmarks and other synthetic benchmarks. Several designed their graphics drivers to take advantage of the repetitive operations of the benchmarks by caching only one type of object. Others implemented elaborate bitmap caching and drawing schemes. In our last major review of video cards (April 13, 1993, "Graphics Accelerators: Waking Up Windows"), we reported that some products were running up scores in the Graphics Winmarks that did not reflect their performance in our application suite. Some strategies, such as text string caching, performed by Number Nine's #9GXE and the Hercules Graphite Card, seemed designed solely to increase

HIGHLIGHTS

Windows Accelerators

SPEEDING UP GRAPHICS applications in Windows is the main purpose of the eight graphics accelerator cards in this review. They work by shifting common graphical operations from the system's CPU to custom chips on the graphics card. The cards in this review use several different graphics chips, including those from S3 Corp., Integrated Information Technology Inc., and ATI Technologies Inc.

SOFTWARE DRIVERS are the key to an efficient graphics card. They determine which graphical operations to process, which objects to cache, and how compatible the card is with the myriad Windows programs on the market.

HYPED-UP BENCHMARK SCORES are great marketing tools, but they don't do much for the average user. In this second look at past Editors' Choice award winners and cards whose performance has been questioned, we asked vendors to provide drivers without engaging in false optimization practices, running up Winmark scores without providing extra benefit to the user.

GRAPHICS WINMARKS measure graphical operations. Our suite of Windows apps tests exercises the entire system, including CPU, hard disk, and memory, yielding a measure of real-world performance to weigh against Winmarks scores.

SPEED ISN'T EVERYTHING in a graphics accelerator. The ATI Graphics Ultra Pro, for example, blazed through our Winmarks test but stumbled on the applications suite because of a bug. You want a graphics card that offers stability and reliability as well as good performance. Consider the reliability of the vendor and the quality of tech support.

Our Contributors: BEN MYERS is a frequent contributor to *PC Magazine.*

Winmark scores with no benefit to users.

The issue of so-called false optimization quickly became a computer industry controversy. Vendors complained that they had been unfairly maligned and pointed fingers at each other's practices. Industry experts took sides. Pundits threatened to "expose" companies that played tricks with their software drivers.

To clear the air, *PC Magazine* invited eight graphics vendors to submit ISA bus Windows accelerators for review with the latest shipping version of their Windows 3.1 driver. All eight companies were either recent recipients of *PC Magazine* Editors' Choice awards or vendors whose driver optimization we had called into question. We told the companies that we would test the cards with both Winbench and a suite of Windows applications. But we also warned vendors that we would be paying close attention to false optimization techniques in the software drivers.

The eight products retested in this review include the ATI Graphics Ultra Pro, the Cardinal VideoSpectrumXL, the Diamond Stealth Pro, the Hercules Graphite Card, the Metheus Premier 928, the Volante Warp10 Plus, the Number Nine #9GXE, and the Orchid Fahrenheit VA. Each was tested in a Compaq 486/33M. We used Winbench 3.11 and our applications test suite, which includes Microsoft Excel, CorelDRAW, Superbase, and Lotus Ami Pro. Each was tested at 800-by-600 resolution and 256 colors with the default settings.

Our test results show that while some optimization techniques can help crank up Graphics Winmark scores, they have a more ambiguous impact on everyday use. We are not surprised by the differences between Winmark and applications scores. The Graphics Winmark score is purely a measure of graphics operation; the applications test suite exercises the entire PC, including the hard drive, CPU, and main memory. While Winmarks' weighed average was based on a broad set of popular applications, we used just a subset of these applications for the tests presented here. What does alarm us is the effect that tweaking the driver can have on stability. For example, ATI's Graphics Ultra Pro card, which ran up the highest scores in the Graphics Winmarks section of our testing in its default mode, hung on the Excel portion of our applications test.

In their default configurations, the Hercules, Orchid, and Diamond cards turned in the highest scores in our applications test suite, and the scores were grouped fairly closely together. The Metheus, National Design Inc. (NDI), and Number Nine cards formed a second, slightly—but significantly—slower group. The ATI card, which couldn't complete the tests with its default switches on, fell between the first and second groups of cards once polygon support, an undocumented default option that speeds up the drawing and filling of irregularly shaped objects, was turned off. These broad groupings are more significant than individual scores because repeated applications tests in Windows can vary as much as 5 percent. When the ATI card was set so it could complete the Windows Applications test suite, the spread between the fastest and slowest graphics cards in this review was only 8 percent.

Because of the large number of software switch settings available on the ATI card, we decided to take a closer look at them to get a better understanding of the effect of current optimization techniques on applications. With all options off, ATI's card was slowest running Ami Pro and was in the middle of the pack on the other applications. With ATI's polygon option on, the card returned the fastest score on the CorelDRAW test. This is probably because the CorelDRAW test

EDITORS' CHOICE

- **Diamond Stealth Pro**
- **Hercules Graphite Card**

In analyzing the results of our retest of graphics accelerator cards for Windows, we looked at both the Graphics Winmark scores from Winbench 3.11 and the scores of a suite of Windows Applications tests to get a broad portrait of graphics performance.

Wary of unwarranted attempts by vendors to crank up their scores in Winmarks, we have concluded that you should look at scores for both tests.

We award two Editors' Choice awards. One goes to the Diamond Stealth Pro, a solid performer that scored well in both areas. Based on the S3 928 chip and making using of video RAM (VRAM) memory, the Diamond card will serve you well across a broad range of Windows applications.

Our second Editors' Choice award goes to the Hercules Graphite Card, which uses the IIT AGX014 as its graphics chip. While the Hercules did not fare as well on the Graphics Winmarks as did some of other cards in this review, it more than made up for that performance by blazing through our Windows Applications test suite. At $399, the Hercules Graphite is a solid buy that won't leave you counting pixels during a screen redraw.

The Orchid Fahrenheit VA deserves honorable mention. Using the 801 chip from S3 Corp. and cheaper and slower dynamic RAM (DRAM) memory, the Fahrenheit VA plodded through our Graphics Winmarks but still managed to come in second in our applications test suite. With a street price under $200, the budget-minded will find this card an excellent buy.

While the ATI Graphics Ultra Pro, a previous Editors' Choice winner, aced the Graphics Winmarks, it stumbled on our applications suite. Driver stability is an important issue, and too many driver revisions make us wary of recommending the ATI.

Benchmark Tests: Video Boards

The cards with the fastest applications scores—the Hercules Graphite Card and Orchid Fahrenheit VA—had fairly low Graphics Winmark scores. Some companies try to crank up their Winmark scores without giving real benefit to the user.

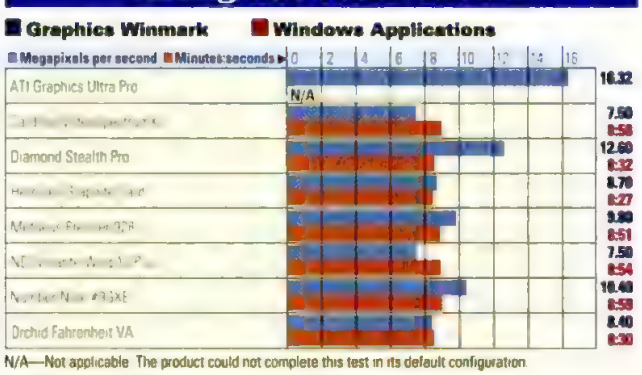
What the Numbers Mean

On a Compaq Deskpro 486/33M with 8MB of RAM, we tested the eight graphics cards with their default software configurations. This is how you would most likely use them, since most of the driver options are not documented in the products' manuals. To learn all about the options, you have to look at README files, download supplementary information from vendor bulletin boards or CompuServe, or snoop in the Windows SYSTEM.INI or WIN.INI files.

Three of the seven cards that ran our Windows Applications test suite clustered at the head of the pack with results within 5 seconds of each other, well within our margin of error. The performers with the fastest applications times—the Hercules Graphite Card and Orchid Fahrenheit VA—had fairly low Graphics Winmark scores. The Diamond Stealth Pro, third in applications testing, had the second-highest Winmark score.

The last four finishers were also clumped together, at least 24 seconds away from the fastest group in the applications suite, with mixed results in Graphics Winmark testing. ATI's Graphics Ultra Pro could not finish the applications suite—it hung the system during the Microsoft Excel test—but it turned in the highest Graphics Winmark score.

Rating the Video Cards



N/A—Not applicable The product could not complete this test in its default configuration
Graphics Winmark Higher scores represent better performance
Windows Applications Lower scores represent better performance

How We Tested

The **Graphics Winmark** score is based on 12 Windows graphics and text functions derived from extensive profiling of popular Windows applications. It is measured in megapixels per second (a megapixel is 1,048,576 pixels).

Our **Windows Applications** test suite measures a system's ability to perform four Windows applications. The Ami Pro and Microsoft Excel tests emphasize processor and video speed. The CorelDRAW test focuses on processor, video, and disk performance, and the Superbase test is mostly disk-oriented. Because the results are given in seconds, lower scores represent better performance.

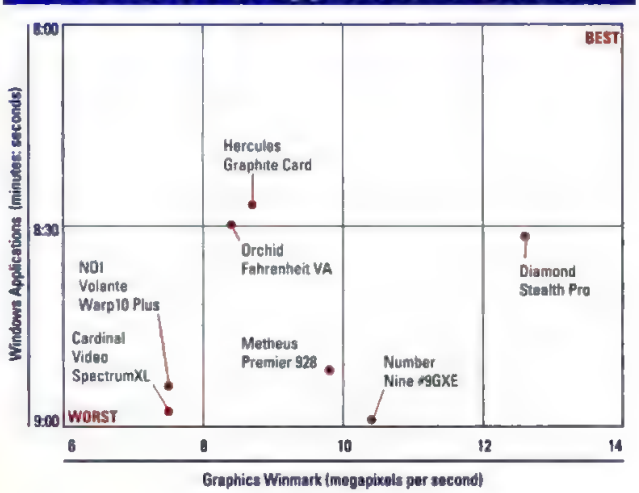
We've also plotted each card's Graphics Winmark score against its applications score . The "sweet spot" is the upper-right-hand corner of the chart.

Breaking Down the Apps Scores

Minutes:seconds	Ami Pro	CorelDRAW	Microsoft Excel	Superbase
ATI Graphics Ultra Pro	1:05	2:01	N/A	3:54
Cardinal VideoSpectrumXL	1:09	2:03	1:49	3:57
Diamond Stealth Pro	1:10	2:00	1:33	3:48
Hercules Graphite Card	1:08	1:56	1:39	3:44
Metheus Premier 928	1:09	2:07	1:42	3:53
NDI Volante Warp10 Plus	1:16	2:04	1:39	4:00
Number Nine #9GXE	1:11	2:23	1:34	3:51
Orchid Fahrenheit VA	1:07	2:00	1:41	3:43

N/A—Not applicable The product could not complete this test in its default configuration
Lower scores represent better performance

Winmark vs. Applications Scores



creates a number of irregular shapes that have to be filled. With both bitmap and polygon support off but font caching on, ATI turned in the best scores for Ami Pro. The Superbase test is not affected much by optimizations because the database program makes minimal use of graphics operations.

Optimization will remain a controversial issue. We expect the techniques to evolve as the technology advances. Based on our tests of these particular graphics cards, we conclude that font caching as implemented today has a greater overall impact on applications than other optimization techniques. We conclude that you are better off with a board that gives you a combination of good Winmarks scores and good scores in our applications test suite. (See chart.)

Later this year, *PC Magazine* and ZD Labs will release Winbench 4.0, which uses some innovative techniques to measure graphics performance and to ferret out false optimization. We will also be releasing the first version of Winstone, our first applications benchmark tests.

While the differences among the eight graphics cards in overall performance in applications were slight, we did see some

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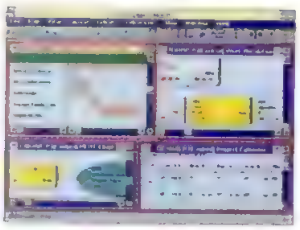

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small performance differences in specific applications that make heavy use of graphics functions, such as CorelDRAW. However, be concerned about the stability of the drivers that come with your graphics card and their compatibility with the most common Windows applications. Your buying decision should also consider the quality of technical support and the reliability of the vendor, the type of warranty, and, of course, price.

ATI GRAPHICS ULTRA PRO

The $799 ATI Graphics Ultra Pro is powered by ATI's own mach 32 graphics chip. ATI supplied the latest version of its Windows driver, Release 2.0, Build 65 for this test. In the default mode, the Ultra Pro blazed through the Graphics Winmarks tests with a top score of 16.2 million. However, speed isn't everything. The Excel 4.0 section of our applications test hung repeatedly. The culprit was ATI's default polygon support, which draws and fills irregularly shaped objects and conflicts with Excel. When we turned polygon support off, the Ultra Pro completed the applications suite and ranked second with a total time of 8 minutes 29 seconds. However, the ATI's Winmark score also dropped, placing it second, slightly behind the Diamond Stealth Pro.

According to ATI, the problem is a bug it reintroduced while fixing another problem with the driver. Our problem with ATI's polygon support is that it isn't documented anywhere in the manual. You only learn the solution by calling ATI's tech support or signing on to their bulletin board (416-756-4591) or CompuServe support forum (Go ATITECH).

Despite these problems, the Ultra Pro has a large number of attractive features. Shipped with 2MB of VRAM, it supports resolutions up to 1,280-by-1,024 at 256 colors, 1,024-by-768 at 65,536 colors, and 800-by-600 at 16.7 million colors. You can set up a virtual screen, allowing you to pan and zoom around a screen larger than your monitor's screen. A feature called Crystal Fonts offers anti-aliased fonts sharper than standard screen fonts. You have to decide whether the added features are worth the risk of incompatibility and frequent driver revisions.

CARDINAL VIDEOSPECTRUMXL

Cardinal's VideoSpectrumXL is a no-frills card with a Cirrus Logic GD-5426 graphics accelerator and 1MB of 45 nanosecond DRAM. A control panel that you install in Windows allows you to change resolution and color depth and font size from within Windows 3.1. While the amount of graphics memory cannot be expanded, the card supports 640-by-480 at 16.7 million colors, 800-by-600 at 65,536, 1,024-by-768 at 256 colors, and 1,280-by-1,024 interlaced at 16 colors.

The VideoSpectrumXL ranked at the bottom of the list in both the Graphics Winmarks and applications performance. However, it managed to score in the middle of the pack on the Ami Pro section of the applications test.

If you're not doing anything terribly exotic in Windows, this card, with a list price of $149, will give you decent performance.

DIAMOND STEALTH PRO

The Diamond Stealth Pro uses the latest graphics accelerator from S3 Corp., the 928 chip. However, Diamond augmented S3's core driver with its own enhancements, and this effort shows up in solid performance. With 1MB of VRAM, the Stealth Pro handles resolutions up to 640-by-480 at 16.7 million colors, 800-by-600 at 65,546 colors, 1,024-by-768 at 256 colors, and 1,280-by-1,024 interlaced at 16 colors.

The Stealth Pro has a socket for an additional 1MB of VRAM ($150), which allows resolution of up to 800-by-600 at 16.7 million colors, 1,024-by-768 at 65,536 colors, and 1,280-by-768 at 256 colors.

The Stealth Pro was the second-fastest card in both the Graphics Winmarks (12.6 megapixels per second) and the applications test suite (511.69), just ahead of the Orchid Fahrenheit VA. It turned in the fastest scores on the Excel portion of the applications suite and ranked third in the CorelDRAW and Superbase sections. It lagged only in running Ami Pro, but just 5 seconds behind the leader, ATI. At a price of $349 with 1MB of memory, and another $150 for the extra 1MB of RAM and a RAMDAC chip to increase

FACT FILE

ATI Graphics Ultra Pro, ISA Version
ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2; 416-756-0718; fax, 416-756-0720.
List price: With 2MB VRAM, $799.
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Cardinal VideoSpectrumXL
Cardinal Technologies Inc., 1827 Freedom Rd., Lancaster, PA 17601; 717-293-3000; fax, 717-293-3055.
List price: With 1MB VRAM, $149.
476 ON READER SERVICE CARD

Diamond Stealth Pro
Diamond Computer Systems Inc., 1130 E. Arques Ave., Sunnyvale, CA 94086; 408-736-2000; fax, 408-730-5750.
List price: With 2MB VRAM, $499.
477 ON READER SERVICE CARD

Hercules Graphite Card
Hercules Computer Technology Inc., 3839 Spinnaker Ct., Fremont, CA 94538; 800-532-0600, 510-623-6030; fax, 510-623-1112.
List price: With 1MB VRAM, $399.
478 ON READER SERVICE CARD

Metheus Premier 928
Metheus Corp., 1600 NW Compton Dr., Beaverton, OR 97006-6905; 800-638-4387, 503-690-1550; fax, 503-690-1525.
List price: With 1MB VRAM, $399.
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Volante Warp10 Plus
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Number Nine #9GXE
Number Nine Computer Corp., 18 Hartwell Ave., Lexington, MA 02173; 800-438-6463, 617-674-0009; fax, 617-674-2919.
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Orchid Fahrenheit VA
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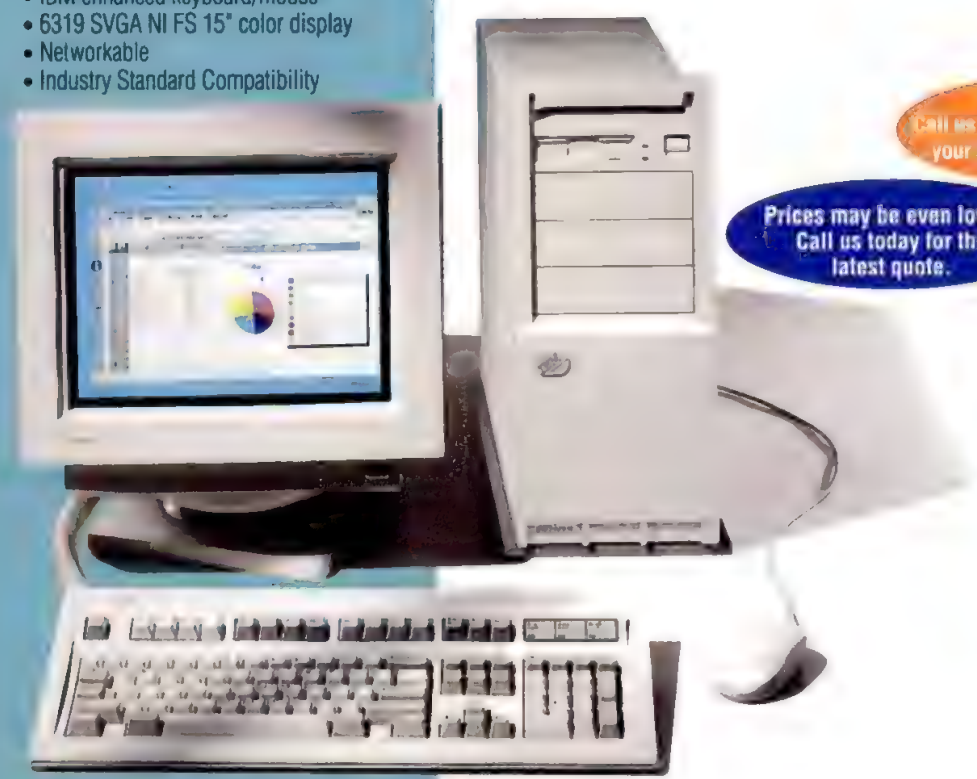

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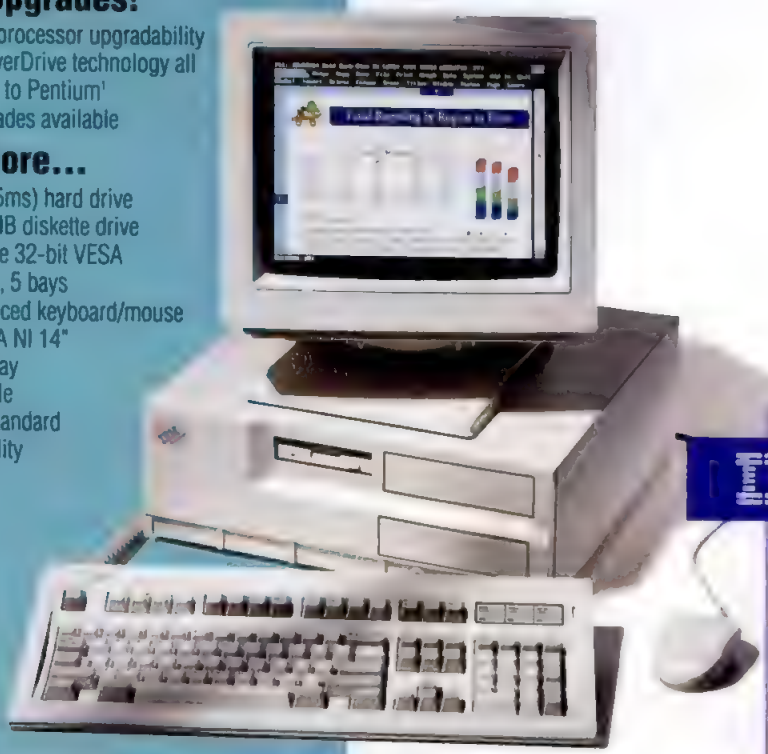

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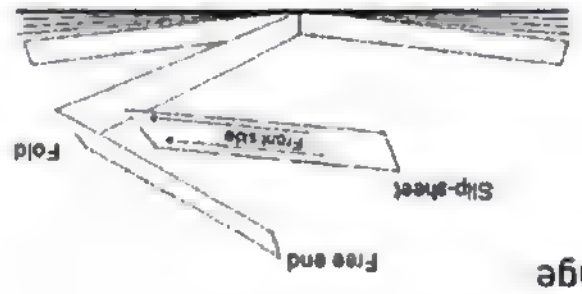

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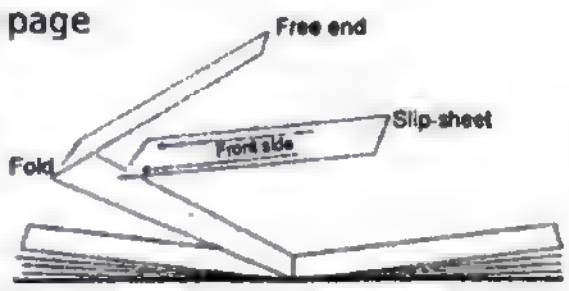

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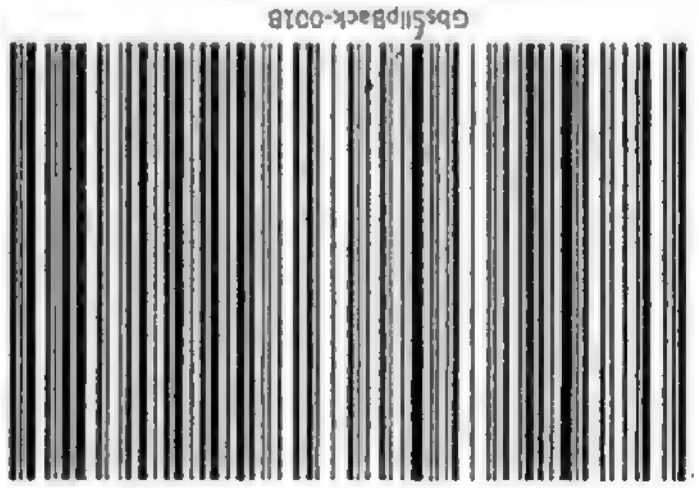

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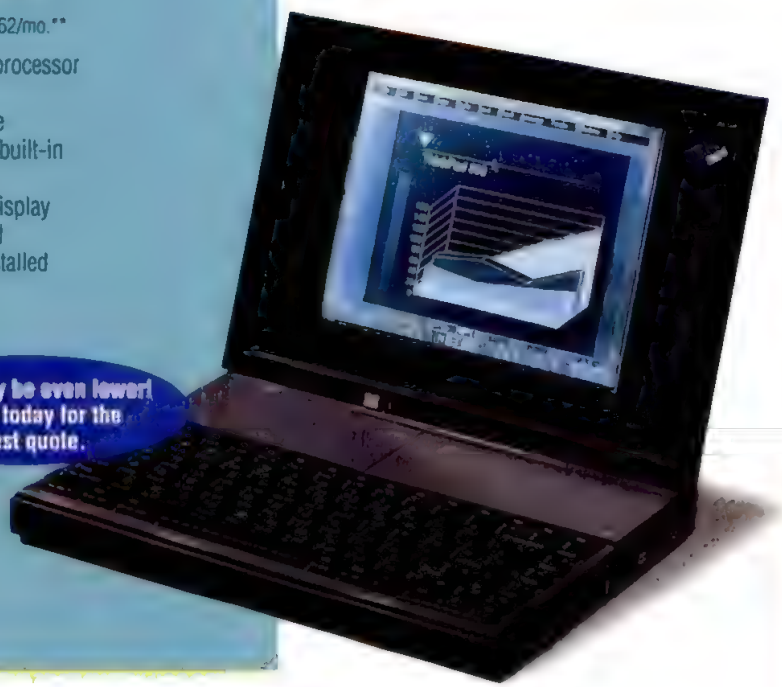

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color depth, the Diamond Stealth Pro remains a sensible buy.

HERCULES GRAPHITE CARD

The Hercules Graphite uses IIT's AGX014 chip and comes with 1MB of VRAM. The IIT chip, from a company better known for math coprocessors, is based on the IBM Extended Graphics Array (XGA) standard and is shipped with drivers supplied by IIT and modified by Hercules. The card can reach a maximum resolution of 1,280-by-1,024 at 16 colors with 1MB of RAM. It was at the center of our benchmark controversy several months ago because its drivers cached the complete text of "The quick brown fox. . ." used by earlier versions of Winbench. This resulted in very good Winbench scores, but we disallowed them. Winbench 3.11 removes the benefits of text string caching, which has no perceivable benefit to the user.

In this round, Hercules supplied new drivers without the false optimization. The Graphite Card scored a pedestrian Winmark score of 8.7 megapixels per second. However, the Graphite eked out the top speed of 8 minutes 26 seconds in the applications tests, nosing out the ATI Ultra Pro (when enabled to complete the tests) by 3 seconds. This card turned out the highest scores in the CorelDRAW section of the applications test, 26 seconds ahead of the #9GXE, which was last in this segment. The Graphite Card ranked second or third in all the other sections of the applications test.

At a price of $399 with 1MB of VRAM memory, the Hercules Graphite gives solid performance for a reasonable price.

METHEUS PREMIER 928

The $399 Metheus Premier 928 tested by PC Labs came with 1MB of VRAM and used the ubiquitous 928 chip from S3 Corp.

The graphics drivers come from S3 and provide a single switchable option: polygon support, which speeds up the drawing and filling of irregularly shaped objects. The option's default position is off, and it is not documented, as is the case with all the S3 drivers. When polygon support is turned on, Metheus' Graphics Winmark score leaped from 9.8 to 14 megapixels per second. We could find no benefit to the typical user in turning on the option, since the application test scores produced by the Premier 928 remained virtually identical (8 minutes, 51 seconds) with polygon support on or off. This score places the Premier 928 solidly in the middle of the pack.

With the option of increasing memory to 4MB, the Premier 928 is an attractive choice if your work requires a combination of high resolution and color depth, but disregard Metheus' benchmark claims and do your own application tests.

VOLANTE WARP10 PLUS

National Design Inc.'s Warp10 Plus uses the 801 version of S3's family of accelerator chips. The 801 is designed to work with less expensive DRAM chips. The drivers for the Warp10 Plus drivers betray their S3 origins by providing the same polygon setting option as the Premier 928—and with the same lack of effect beyond cranking up Winmarks scores. In this case, the results on both sets of tests left the 1MB Volante Warp10 Plus at the bottom of the pack. Its Graphics Winmarks dropped from 8.9 (it would have ranked fifth) to 7.5 megapixels per second (tied for last) when the polygon setting was turned off.

The Hercules Graphite eked out the top speed of 8 minutes 26 seconds on the applications test suite.

The 1MB Warp10 Plus also tied for last place in the applications test suite, turning in an identical score of 8 minutes 54 seconds with the polygon support option on or off. The lack of effect of the polygon option marks the Warp10 as another card optimizing for Winmarks scores and little else. At a price of $299, the Volante Warp10 Plus is cheap, but no bargain if you're looking for performance in this price range.

NUMBER NINE #9GXE

The basic $495 #9GXE from Number Nine Computer is another VRAM card that uses the S3 928 graphics chip. The #9GXE has a rich set of features. You can zoom and pan around an area within a larger virtual screen (up to 2,048-by-2,048), and you can calibrate the size and shape of your monitor image while inside the Windows environment.

The #9GXE turned in an eye-popping 28.1 megapixels per second the last time we reviewed it, using a text-caching scheme that stored text strings that are used repeatedly.

While Number Nine initially objected to our decision to consider bitmap caching a legitimate option, the company has now implemented its own version of this approach, which it calls TurboCopy. With TurboCopy on, the #9GXE's score on the Graphics Winmarks climbed from 10.4 to 11.6 megapixels per second. But its score on the applications suite increased only marginally, from a last-place 8 minutes 59 seconds to 8 minutes 56 seconds, slightly ahead of the VideoSpectrumXL (but within the margin of error in testing). Despite its checkered Winbench track record, the #9GXE deserves consideration if one or more of its features can improve your productivity.

ORCHID FAHRENHEIT VA

This card is unique among those reviewed here because it adds sound capability. (The sound capabilities of the Fahrenheit VA were not tested for this article.) It is based on S3 801 graphics chip and ships with 1MB of DRAM. Like some of its competitors, it allows you to set up a virtual screen at a resolution of 1,280-by-960 at 256 colors.

Orchid's drivers for this card do not include the polygon support settings normally provided in the basic S3 driver. There are no switchable options.

The Fahrenheit VA's Winmark score of 8.4 megapixels per second placed it next to last. However, it ranked third on the applications test suite with a respectable time of 8 minutes 30 seconds. The Fahrenheit VA turned its best scores in the CorelDRAW and Ami Pro sections of the applications suite, ranking second in both. However, it fell to fifth on the Microsoft Excel test, a full 8 seconds behind Diamond's entry.

A respectable showing in the applications tests and the addition of sound at an affordable $299 make it an attractive choice in the 1MB category. □

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CIRCLE 079 ON READER SERVICE CARD

SYSTEM REPORTING SOFTWARE

Taming Your IRQs

Today's Perfect PC is packed with peripherals, each making demands. As mice and modems, CD-ROMs and scanners proliferate, so do control conflicts.

by Barry Simon

Keeping tabs on your system's resources—like IRQs, DMAs, and I/O ports—is a tough job. When you bought your first XT, you never dreamed you'd need special software to tell you about the hardware inside. But today, as you add peripherals, you'll find each demanding system resources.

Tracking resource usage isn't easy. For example, do you know which IRQ is assigned to which COM port? What the I/O port addresses are? A good system reporting package can handle these details.

IN THIS REVIEW

CheckIt PRO: SysInfo 266
InfoSpotter 267
Landmark SysInfo 276
µPC-Doctor 276
QA Plus 275
QAPlus/WIN 275
Skylight 267
System Sleuth Professional 285
WinProbe 276
WinSleuth Gold 285

TEST, DIAGNOSE, REPORT

What about scanning your hard disk

Illustration by Richard Osaka

for bad sectors? Checking your file allocation table for errors? Testing memory chips? Some of the products we review here do some of those things, but that's not what we evaluated. We focused on system reporting: Was it thorough? Accurate?

Actually, these packages first *test* your system, then report on what they find. To qualify, packages had to do at least some testing by directly accessing the hardware. Programs that just read what's in memory and report on what they find tell only part of the story. For example, they could easily miss your Sound Blaster board because its DOS drivers are loaded only when applications want to use it.

Where we had a choice between two or more products from a given vendor, we chose the entry-level one because we wanted to focus on the ones that target end users rather than repair technicians. Nine products from six vendors—four Windows-based and five DOS-based—met our selection criteria.

Vendors like Symantec Corp. and Central Point Software roll everything but the kitchen sink into one package (see the sidebar "Reporting á la Carte" for an evaluation of these products).

WHAT HAPPENED!?

Typically you use reporting software *after* you've made a change to your system. Suddenly a part of your system that used to work doesn't work any more. Why? Every time you install an expansion board, you (or the install program) must give it an IRQ (Interrupt ReQuest line) and/or a DMA (Direct Memory Access) channel and/or an I/O port. Since these are limited resources, *you run the risk of conflicting with an existing assigment.*

While there are 65,536 I/O ports, for example, all default to the first few hundred numbers. AT-class and later machines have 15 usable IRQs, but since the system itself uses four to nine and since most add-on boards use at least one, IRQs are the most likely source of system conflicts. Fortunately, the eight DMA channels typically provided are usually sufficient.

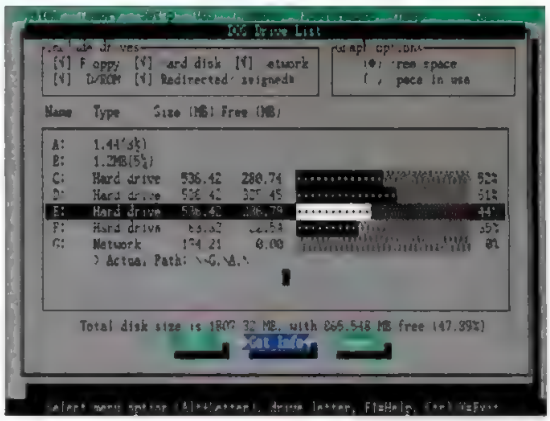
You don't need to understand how these things work to install a board, but you *do* need a way to avoid conflicting assignments: You don't want a parallel port and a Sound Blaster card duking it out for the same IRQ, or your SCSI controller and your scanner set to the same DMA channel.

WHAT WE FOUND

We used two computers in our tests. The first machine was a complex, high-end 486/66 DX2 VESA local bus with 32MB RAM; it had a local-bus SCSI (attached to two hard drives, a tape drive, and a CD-ROM), two monitors (a local-bus VGA and a monochrome MDA), a Sound Blaster Pro card and a scanner. The other system was a standard, plain-vanilla 486/33 with an internal modem and a CDPC multimedia upgrade kit.

Only two programs reported completely correct information on our test systems: CheckIt PRO: SysInfo and μPC-Doctor. Also, we found surprisingly little unanimity in the information reported. CheckIt PRO: SysInfo, for example, doesn't report on DMAs; μPC-Doctor, on I/O ports. (We required the programs to report on two out of three items).

While the packages reviewed below are clearly far from perfect, they're your best answer to the system-conflict problem for the foreseeable future.



CheckIt Pro's panels are sprinkled with GetInfo buttons that give you further detail.

TouchStone Software Corp.

CheckIt PRO: SysInfo

TouchStone Software's $100 CheckIt PRO: SysInfo is the closest thing this category has to perfection. It made no errors reporting on either of our test systems, and it provided more detailed information on many hardware items in our testbed PCs than did the competition.

CheckIt PRO successfully located the Sound Blaster-compatible cards and the IRQs and I/O ports they used, noted which serial ports on our test machines had an advanced 16550 UART and which the older 16450, and correctly identified which COM port had a modem.

Similarly, CheckIt PRO had no trouble locating programs loaded into high memory under QEMM, DOS 5, or DOS 6. It even got information about the chip sets used on the video cards. On one test machine, it accessed low-level drive remapping data. Some SCSI cards are also supported, but the UltraStor on our high-end test system was ignored.

WINDOWS AWARE

CheckIt PRO is a DOS application, but it does look for Windows and will report on the basic setup information buried in your WIN.INI and SYSTEM.INI files. It gives you IRQ and I/O reports but no DMA channel information.

One of CheckIt PRO's strongest features is the way it shows performance test data. It runs CPU, disk, and video benchmark tests and offers to compare the results with an array of 15 systems ranging from an 8088 to a 486/50.

CheckIt PRO lacks the overall depth of Infospotter; it's also missing a hexadecimal memory view and a search function in its editor. On the other hand, CheckIt PRO's editor has a nice feature for editing your Windows *.INI files. It automatically compiles a pop-up list of all the sections, such as [[386 enhanced]] and [[Mouse]]. Also, CheckIt PRO's strong help section includes valuable information on power usage in typical com-

Our Contributors: BARRY SIMON is a contributing editor to *PC Magazine*. TED STEVENSON was the associate editor in charge of this story, and BEN Z. GOTTESMAN was the project leader.

Product Photography by Thom O'Connor

ponents, memory conservation tips, and a list of standard IBM BIOS POST error codes. All this, combined with a near-perfect reporting performance, makes this product a real diagnostic pro.

▶ FACT FILE

EDITORS' CHOICE CheckIt PRO: SysInfo
TouchStone Software Corp., 2130 Main St., #250, Huntington Beach, CA 92648-2478; 800-531-0450, 714-969-7746; fax, 714-960-1886.
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RenaSonce Group Inc.

InfoSpotter
Skylight

RenaSonce Group's $80 InfoSpotter, Version 3.0 and $100 Skylight, Version 3.0, are well-thought-out, intuitive programs that provide most of the information you would want from a reporting program. To their credit, both do it with considerable depth and verve.

Most reporting packages simply display a list of programs in memory. But with InfoSpotter's list you can highlight a program, hit Enter, and get a byte-by-byte readout of the memory area that the program occupies. In this context, specified function keys let you display the program segment prefix (PSP) and/or environment.

InfoSpotter always tries to give you as much information as possible. For example, the PSP display is not just a pure hex dump, but one that labels the information according to its use. Also, the section of the PSP reserved for the file handle table is labeled as such.

InfoSpotter includes information on all IRQs, available I/O ports, and DMA channels. One of its few problems was that it failed to locate the DMA channel used by the Sound Blaster Pro card on our high-end test-bed system.

You can also load InfoSpotter as a somewhat oversized TSR. However, since it takes 110K of conventional memory, that's probably something you'll do only under special circumstances. For example, it could be useful if you want to find what interrupts an application program is grabbing.

About the only glitch we found was that InfoSpotter incorrectly reported partition table information on our test machine with a 500MB+ hard drive.

PC MAGAZINE ▶ EDITORS' CHOICE

- **CheckIt PRO: SysInfo**
- **Skylight**

Quality of information is the key to a good reporting tool. As such, the program of choice for DOS users is TouchStone's CheckIt PRO. Certainly RenaSonce Group's InfoSpotter, with its elegant interface and ability to drill into the details of memory, as well as Watergate Software's μPC-Doctor, Version 1.0, whose reports were completely accurate, are both excellent choices, but CheckIt PRO (which also reported everything correctly) has a depth of detail that makes it stand out.

Beyond the basics, CheckIt PRO reports on detailed drive mapping with suitable disk controllers and on the kind of UART your serial ports are using. Adding to CheckIt PRO's appeal is a set of benchmark comparisons that allows you to make sense out of the numbers that the benchmarks produce. If you get the SysInfo package and have any interest in diagnostics, you should consider the bundle of SysInfo with CheckIt's "Test & Tools".

This genre of software illustrates the lesson that the leading players aren't necessarily the same on the opposite sides of the DOS/Windows divide. CheckIt PRO and QA have been long established in the DOS world, but there isn't yet a CheckIt for Windows, and QAPlus/WIN is tepid in comparison with its strongest Windows competitors.

Among the Windows-based reporting tools, the Editors' Choice is RenaSonce Group's Skylight. Users who wish to can use this product to drill down and get technical details on PSPs and other memory structures. Those who don't care about such details aren't burdened with the information. Users should also appreciate the way they can keep backups of basic system files if they edit them with Skylight.

An honorable mention goes to Dariana Software's WinSleuth Gold. WinSleuth is playing leapfrog with Skylight; before RenaSonce released Version 3.0, WinSleuth would have been the likely winner. We also saw an early beta of WinSleuth Gold Plus with spectacular graphics, more accurate and complete information, and an interesting scheme for streamlining board installation. Once it appears, it will give Skylight a run for its money on the Windows side.

The Norton Desktop for Windows, a model of easy information access, wins special kudos for its handling of Windows memory reporting. A nice refinement would be a pie chart to show a breakdown of memory usage by application or library; otherwise, NDW handles this aspect of Windows reporting beautifully.

SKYLIGHT

Skylight, the Windows program, is a model of elegance and clarity. Other Windows reporting tools such as Win Probe and QA/Win give you the ability to edit the four basic system files: CONFIG.SYS, AUTOEXEC.BAT, WIN.INI and SYSTEM.INI, but Skylight takes editing a step further. It saves backup copies of the files it edits in its own subdirectory

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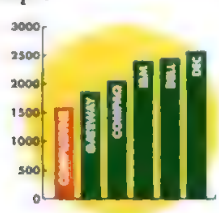

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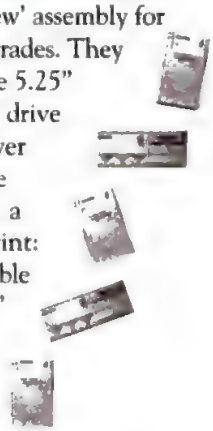

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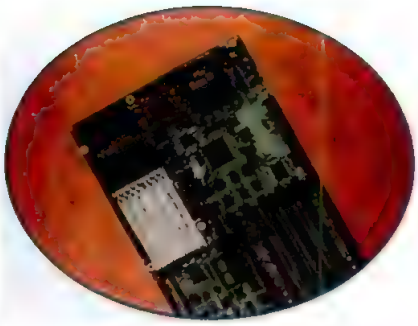

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CIRCLE 132 ON READER SERVICE CARD

Reporting á la Carte

by Barry Simon

It's no coincidence that many of the products we review call their reporting module or reporting submenu *SysInfo*. That's the name that Peter Norton Computing (before it was purchased by Symantec Corp.) gave it in its granddaddy of reporting programs. And today, many users still find all the system reporting they need in one of the utilities supermarkets from Symantec's Norton or Central Point Software.

Another place to find reporting modules is in products that include them technical support tools. Memory manager vendors realized early on that for effective technical support, they had to have easy access to information about their users' systems. So, today, all the major memory management packages include system reporting modules. Similarly, Microsoft Windows 3.1 and DOS 6.0 include an undocumented program (MSD) that may meet your needs. We took a look at the system reporting modules that are a part of these major utilities packages.

THE NORTON SOLUTIONS

Norton Desktop for Windows, Version 2.2 (Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014, 800-441-7234; fax, 408-255-3344; $179), includes a SysInfo module with an elegant interface. It supplies the basic DOS and Windows system information (but no reading of hardware IRQs, I/O ports, or DMA channels) and a CPU benchmark test. A particularly well-done submodule shows bar graphs of memory usage under Windows for Font, Device Driver, System Library, and Application. Click on a bar and you get a window showing precisely the right details: discardable, nondiscardable, and total memory by application. Alas, Norton Desktop for Windows got confused by our test system with more than 32MB of memory and reported total memory as a negative number.

The new Norton Utilities 7.0 ($179) offers the traditional SysInfo plus hardware diagnostics for CPU, memory, controllers, ports, and disk, a hardware IRQ list (that unfortunately failed to identify the Sound Blaster IRQ), and both CPU and disk benchmarks.

THE PCTOOLS SOLUTIONS

PCTools for Windows (Version 1.0, Central Point Software, 15220 NW Greenbrier Pkwy., #200, Beaverton, OR 97006; 800-964-6896, 503-690-8090; fax, 503-690-8083; $179.95) includes a reporting module called System Consultant. It reports on hardware IRQs but it, too, missed the Sound Blaster board. It provides details on heap and resource usage by program but not on the total discardable/nondiscardable memory that will be most useful to end users. It includes a Recommendations button that provided sage advice for the systems we tested.

PCTools for DOS (Version 8.0, $179.95) includes a module called SI, the same name that Norton traditionally gave to its SysInfo program. It provides an array of functions similar to those in Norton Utilities. Like Norton, it failed to find the Sound Blaster on its hardware IRQ list, and it doesn't give I/O port or DMA channel information. But one place where PCTools goes beyond Norton is that it reports on the type of UARTs in your system.

REPORTING TOOLS IN MEMORY MANAGERS

The big three memory management products—NetRoom, Version 3.0 (Helix Software, 47-09 30th St., Long Island City, NY 11101, 718-392-3100; 800-451-0551; fax, 718-392-4212; $99), QEMM, Version 6.02 (Quarterdeck Office Systems, 150 Pico Blvd., Santa Monica, CA 90405; 310-392-9851; 800-354-3222; $99.95), and 386MAX, Version 6.0 (Qualitas, 7101 Wisconsin Ave., #1386, Bethesda, MD 20814; 301-907-6700; $99.95)—all provide thorough reporting utilities.

QEMM includes Manifest, an editor's choice the last time we reviewed reporting software. NetRoom's reporting facility is called Discover, and 386MAX's is called ASQ. All three provide a very similar array of features. As you might expect from their lineage, they are strong on reporting on memory and operating system issues, but weaker on hardware.

None of these report on hardware IRQs, I/O ports, or DMA channels, the triad of issues critical to add-on board installation. Only ASQ reports on disk partition tables, and none report on low-level disk parameters. All provide reports on the logical drives and their free space, the operating system and its basic structures (including file handles and buffers), and detailed reports on programs in memory.

MSD

You likely have one reporting program on your disk that you may not be aware of. MSD (for Microsoft System Diagnostic) is automatically installed on your hard disk by Windows 3.1 and by DOS 6.0. The DOS 6 version is newer, and contains only some bug fixes.

MSD has a list that is called "Hardware Interrupts," but it appears that the program is checking only for the software interrupts associated with the IRQs; it did not find the Sound Blaster card on our high-end system. It does report on some low-level disk parameters but not on the partition tables.

All in all, MSD is a little thin, though it's still a useful program. If you want a quick report and don't have any of the other programs discussed here, it just might do the job.

When looking at these bundled reporting programs, it's helpful to keep in mind that none can match the wealth of detail found in the best of the standalone packages. □

GET READY FOR COLOR!

Color emerges as the new corporate standard

BY ERIC J. ADAMS

EVERY FEW YEARS the corporate world ups the ante. It redefines what it considers "acceptable" output for written communications.

At the dawn of the personal computer age, dot-matrix output was considered adequate. Several years passed before laser-printer output became mandatory. More recently, only documents with multiple fonts have passed the corporate test.

Today, there's a new document standard emerging, perhaps the most dramatic of all. It's color — provocative, bold, and persuasive color.

If you know the corporate world, you know standards aren't whimsically set. And there's good reason why color will succeed where other standards have failed.

Innovators in corporate departments (and not just graphics departments) have discovered that color makes their proposals more convincing, reports more memorable, and sales presentations far more compelling than ever. In short, they're finding that color makes people pay attention.

None of this is new, however. Brochure and magazine designers have long relied on the power of color to enhance their message.

DESKTOP COLOR

What *is* new is the technology that finally makes it easy and affordable to add *professional-quality* color to your communications without leaving your office and without becoming a color expert.

It's called desktop color, and it's poised to revolutionize the way we communicate on paper, transparencies, and slides.

Until recently, you needed a separate color copier, printer, and scanner to include color in your documents. But few workgroups could afford all these devices, and fewer still had the expertise to use them correctly.

Now there's a solution for those who want great color at an affordable price with little or no learning curve. It's the truly revolutionary CJ10 from Canon — the only complete, one-stop color solution designed and priced for the non-graphics professional, yet sophisticated enough for the graphics world as well.

MEET THE CJ10

The compact CJ10 lets you easily add color to your reports, proposals, handouts, transparencies, signs, maps, diagrams, schematics, illustrations, menus, layouts—you name it.

For starters, the CJ10 is a high-quality *digital* 400-dpi copier that utilizes state-of-the-art Bubble-Jet technology. The CJ10 gives you 16.7 million colors that leap off the page (check out the reviews). It pumps out a full-page color copy in about 90 seconds for about one-third the price you'd pay at a color copy shop. As a stand-alone copier, we think the CJ10 is the best low-volume color copier you can buy.

But the CJ10 is far more than a copier. When used with an optional Intelligent Processing Unit (IPU) and your computer, the CJ10 becomes a color scanner and printer as well.

Now you can scan in photos and illustrations for computer enhancement and manipulation. As a color printer, the CJ10 is virtually maintenance-free, and provides better colors than any comparable color printer we've seen.

Scan, print, manipulate, copy, all on the same desktop device — color has never been so easy. Plus you can make color copies from slides and film negatives, make transparencies, and even capture video using the CJ10 and optional equipment.

At a suggested list price of $6,995 ($9,695 with optional SCSI-interface IPU), the CJ10 is the first affordable, high-quality color solution for the office.

Please take a look at the benefits of the CJ10 and see how spectacular — and easy — color can be.

WHY COLOR?

Want to add punch to your message? Color helps you:

- Attract Attention
- Add Impact
- Highlight Critical Facts
- Clarify Complex Information
- Increase Retention and Recall
- Evoke an Emotional Response

COLOR YOUR WORLD

Putting color and the Canon CJ10 to work for you

Whatever you business, color can help you get your message across with drama and style.

IF YOU THINK you can benefit from desktop color, you're not alone. Already thousands of companies, workgroups, and individuals have put the multifunction CJ10 to work for them.

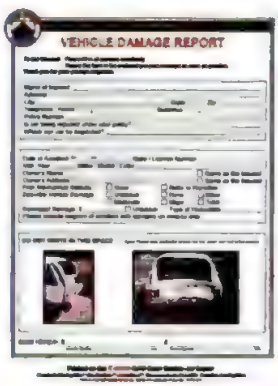
Law firms, for instance, are using the CJ10 to create and distribute evidentiary information in criminal and civil cases. And since the CJ10 is user friendly, attorneys and their assistants don't need special training to create color documents immediately.

Architectural and engineering firms are making heavy use of the CJ10 for job proposals and bid specifications. Since the CJ10 can scan as well as copy and print, these proposals include color photos, renderings, and sketches designed off-line, as well as illustrations created on a computer with a CAD or drawing program.

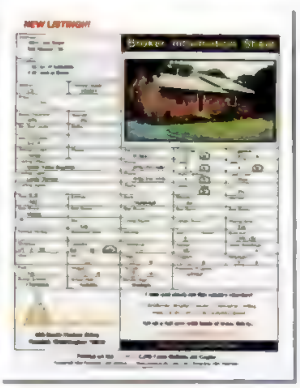
Banks and financial institutions are using the CJ10 to create highly-stylized financial reports and presentations for senior management, board members, and share holders. Presenters don't have to worry about using dated information, since charts, illustrations, and graphics can be updated and reprinted using the CJ10 and an Intelligent Processing Unit.

Architectural

Manufacturing



Insurance



Real Estate

Contractors and developers have discovered that the CJ10 is a great way to put together winning bids, preliminary estimates, prequalification papers, and project management schedules. Color makes the complex look simple, and gives bids an award-winning look. Developers also like the CJ10's ability to quickly reproduce photos for pre-development packets and post-presentation handouts.

Education departments, schools, and universities are putting the CJ10 to work in the classroom with color transparencies and hand-outs for class lectures. And the CJ10 is at work throughout campuses providing distinctive signs and posters for bulletin boards and student and faculty centers.

Insurance companies are speeding up the claims process by including CJ10-generated color photos and collision diagrams in adjuster reports. Meanwhile, sales agents are using the CJ10 to incorporate color flowcharts and diagrams in their presentation materials used to win over customers.

GRAPHIC PROOF

Graphic artists and designers have discovered the CJ10 as an inexpensive and easy way to output highly accurate color composites as a proofing device on four-color marketing and promotional materials.

Manufacturers are finding the CJ10 an accurate and reliable manufacturing tool. Many are using the CJ10 to create and duplicate technical documentation, workbooks, assembly instructions, and manuals for internal staff members and off-site contractors. The highresolution (400-dpi) output of the CJ10 ensures that important details are reproduced crisply and clearly.

Real estate brokers and agencies have increased sales by adding color photos and floor plans to property fliers, property fact sheets, and pitch books. High-impact color documents help attract potential buyers and convey a strong message of success and commitment to potential sellers. Best of all, the cost of reproducing color in-house is often far less than contracting the job to an outside printer.

Training firms are among the most enthusiastic about the CJ10. It allows trainers to develop, print, and duplicate training schedules, certificates, workbooks, instructor guides, transparencies, study reports, and course catalogs.

WHAT'S YOUR LINE?

Whatever you do, chances are there's a way to make it more exciting, expressive, persuasive, and compelling with color. To find out more about the versatile multifunction CJ10, contact your local Canon authorized CJ10 dealer or call **1-800-OK-CANON.**

SHOW-STOPPING COLOR

Easy, affordable, superb color from a multifunction copier, printer, scanner

WHEN DESIGNERS SET OUT to create the CJ10 they had two guiding principles: It should be easy to use, and it should deliver vibrant professional-quality color unlike anything else available at the price.

We at Canon believe the CJ10 has succeeded on both counts.

EASY AS PIE

The CJ10 is as easy to set up and use as a conventional copier or printer, and just as compact. The only replacement items are four Bubble-Jet cartridges, which contain all the important replacement components and are designed to be individually replaceable to keep the cost of consumables low.

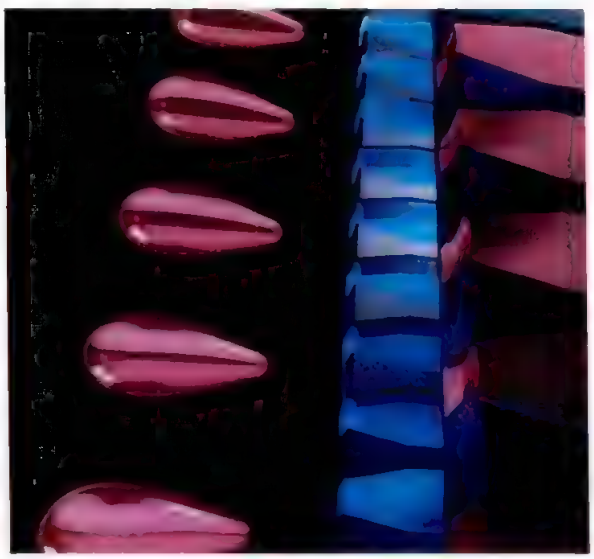
All controls for the CJ10 are located on a front control panel that provides fingertip access to a full range of color functions, such as 50% to 200% Zoom in 1% increments, independent X/Y Axis Zoom, Photo and Color Balance, and multiple copies of 1 to 19.

The 90-sheet paper tray slides out for easy paper loading, and the CJ10 comes with a manual feed system for optional transparencies, label paper, or card stock. Warm-up time is only 10 seconds, so you don't have to keep the CJ10 running between jobs.

The CJ10 platen cover is double-hinged so you can copy directly from thick or bound materials, such as books and technical documentation. And the CJ10 is compact, just nine inches high, 21 inches long, and 19 inches deep.

The CJ10 automatically adjusts color balance for you, but if you want or need special control, you can easily lighten or darken each color and set contrast yourself, again with controls accessible from the front panel.

As a scanner, the CJ10 lets you choose scan resolutions from 72 to 400-dpi, and color depth from 8-bit gray scale to 24-bit color. Printing is as easy, too. The CJ10 allows for automatic or manual color control from your computer's Color Control dialog box, and you can select up to 999 copies when printing.



With precise 400-dpi resolution and 16.7 million brilliant colors, the Canon CJ10 creates bold and realistic output.

The Canon CJ10 is designed to be virtually maintenance free, with Bubble-Jet cartridges that contain all the important components.

All the optional equipment is designed with the same ease-of-use in mind.

VIBRANT COLOR

Whether copying, printing, or scanning, you'll find the color from the CJ10 simply outstanding. With 16.7 million *smudgeless* colors at 400-dpi, the CJ10 offers 33% greater resolution and twice the number of colors as comparable devices. In fact, the CJ10 meets many of the specifications for Canon's high-end Color Laser Copiers.

The secret of the CJ10 is the Bubble-Jet technology and design. Each Bubble-Jet cartridge (cyan, magenta, yellow, and black) contains 128 self-cleaning print nozzles.

The precise print heads and ink nozzles fire approximately 4,000 times *per second*, and are automatically cleaned each time you turn on the CJ10. These "intelligent" cartridges are designed to self-adjust when a nozzle temporarily clogs or misfires.

The CJ10 produces one full-color copy in approximately 90 seconds. To produce the best possible image, Canon supplies a family of coated papers, such as 8.5inch-by-11-inch card stock, transparency film, label sheets and 5.5-inch-by-8.5-inch statement paper.

The CJ10 automatically detects text and overprints with black ink, giving you the best of both worlds — rich, vibrant colors and crisp, clean text.

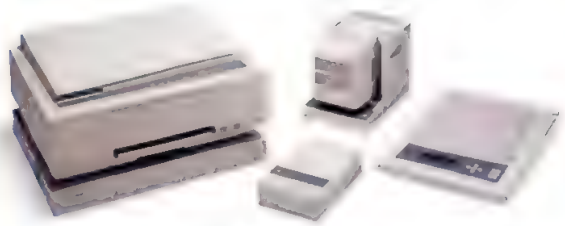
For more information, or to test drive the versatile CJ10, contact your local Canon authorized CJ10 dealer or call **1-800-OK-CANON** today.

EXPAND YOUR COLOR HORIZONS

Optional equipment transforms the Canon CJ10 into a multimedia maestro

YOU CAN TRANSFORM your CJ10 into a full-fledged multimedia workstation with available optional equipment. Here are the major equipment options available for the CJ10. Look for more options from Canon in the near future.

With optional equipment you can turn your Canon CJ10 into a professional workstation. From left to right: Canon CJ10 with an Intelligent Processing Unit, CJ10 Film Projector, CJ10 Intelligent Editor, and Video Adapter 10.



- **Intelligent Processing Unit (IPU) & IPU Kits** To use the CJ10 as a scanner and printer, you'll need an optional Intelligent Processing Unit (IPU) and an IPU Kit to match your computer's bus (Windows/AT® Bus or Windows/MCA Bus).

There are two IPUs available. The IPU SS connects via a SCSI port and includes 2Mb of memory for buffering data.

The IPU DG connects to a General Purpose Interface Board(GPIB) and includes 16Mb of memory.

The IPU and IPU kit include all you need to scan and print in full, high-quality color, and comes with a specially adapted copy of Aldus® PhotoStyler™, a Windows™ printer driver with advanced color adjustment controls, a SCSI Interface Card, SCSI Cable, and software for easy installation and testing.

Additional kits are available for Macintosh® computers.

- **CJ10 Intelligent Editor** This remarkable device literally turns the CJ10 into an image-editing station. Its revolutionary pen-based interface lets you manipulate and enhance images in any number of ways before printing.

You can, for example, select a precise image area to be selected or deleted, reduced or enlarged. You can use the Intelligent Editor to change colors, or add or reduce color gradations.

The Intelligent Editor lets you combine two or more separate images onto the same page or divide a large original for printing in sections on 8.5-by-11-inch paper.

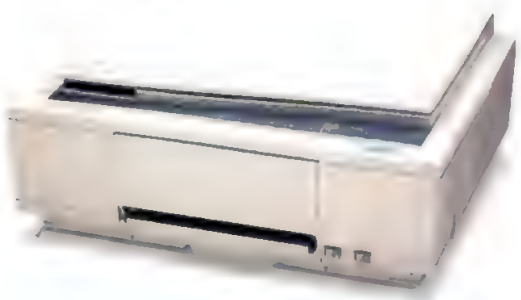
- **CJ10 Film Projector** The film projector is designed for presenters who need a quick and easy way to produce hard copy from 35mm slides or negatives, or those who want to reduce turnaround time and costs associated with producing hard copy.

You can use the Film Projector in conjunction with the CJ10 Intelligent Editor to further manipulate or enhance images. The Film Projector's auto exposure and auto color adjustment ensures high-quality reproductions.

- **Video Adapter 10** The Video Adapter lets you capture NTSC video images from a number of sources including VCRs, television monitors, video cameras, and still video products. By hooking the adapter to the CJ10 via the Intelligent Processing Unit, you can capture images to your computer's memory for later image retrieval and manipulation.

Discover the world of desktop color

WHEN IT COMES TO improving your presentations and written communications, nothing comes close to the power of color. The CJ10 is an easy-to-use desktop solution designed to deliver high-quality color at an affordable price.



A copier, printer, and scanner, the Canon CJ10 is the clear choice for all your color needs.

With the CJ10 and optional Intelligent Processing Unit you can copy, scan, and print color documents and transparencies, making it possible for the first time to bring the power of color to everything you do.

To learn more about the power of color and the multi-function CJ10, call your local Canon authorized CJ10 dealer or **1-800-OK-CANON**.

Canon CJ10 COLOR BUBBLE-JET COPIER

Windows is a trademark of Microsoft Corporation. AT is a registered trademark of International Business Machines, Inc. Aldus is a registered trademark and PhotoStyler is a trademark of Aldus Corporation. Macintosh is a registered trademark of Apple Computer, Inc.

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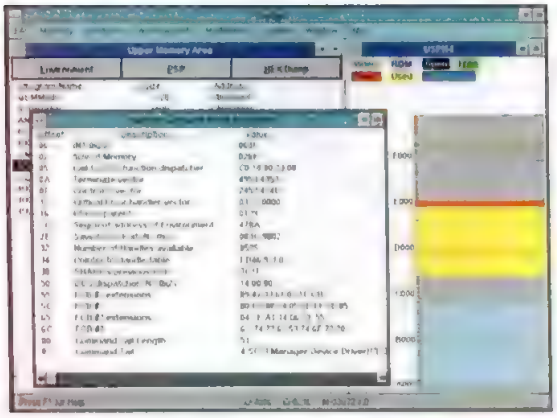
and lets you attach comments to the backups. Later, you can pop up a list of the backups, check the comments, and easily restore the backup version.

Skylight's detailed reports on memory and resource usage are unique and useful. You can display or print a report on memory used, as well as discardable and nondiscardable memory. (Windows can also identify and remove some discardable parts of programs from memory, then later reload them from disk). Skylight also tells you how much of the global resource heap the program uses.

Skylight gives you readings of IRQs and I/O ports but not DMA channels (RenaSonce Group feared that testing them under Windows could make the system unstable), as well as general hardware information. A wealth of detailed information, such as number of colors supported and BitBlt support, is available for screen and printer drivers. A unique reporting module for multimedia showed that while the Sound Blaster Pro supports stereo and 44-kHz sound, it doesn't support both at the same time!

Other RenaSonce Group products are Remote Rx ($129.95)—a diagnostic tool linked to a remote communications module, and SB Pro ($149.95)—a Self-Booting Diagnostic Disk. Among the packages reviewed here, InfoSpotter and Skylight stand out as products that exude intelligence in function and design.



Skylight lets you drill down to get more detail. Highlight an entry, hit the "PSP" button, and up pops a report.

▶ FACT FILE

InfoSpotter, Version 3.0 and
EDITORS' CHOICE ▶ Skylight, Version 3.0
RenaSonce Group Inc., 5173 Waring Rd., #115, San Diego, CA 92120, 619-287-3348; fax, 619-287-3554.
List prices: *InfoSpotter, $79.95; Skylight, $99.95*
Circle 457 on reader service card

DiagSoft

QA Plus
QAPlus/WIN

The QA family of products from DiagSoft has a strong and devoted following in the marketplace (nearly 3 million users, according to DiagSoft). Those we looked at for this review—the $160 QA Plus (for DOS) and the $160 QAPlus/Win—proved competent reporting tools. However, the Windows product's poor use of the GUI environment and the uninspiring abilities of both programs left us wondering if loyal QA users will be satisfied.

QA/DOS reports basic system information and runs tests on memory and video. It includes low-level formatting for older MFM drives and a floppy disk drive head cleaner that runs with a special drive-cleaning floppy disk inserted in the drive. QAMatch, a useful program that comes with both the DOS and Windows packages, compares files in a side-by-side view and shows the differences between the two.

But the information reported lacks depth. QA/DOS reports on free IRQs and DMA channels, but not on I/O ports. On our tests, it reported on the programs loaded in conventional memory and on those in high memory under DOS 5 and 6, but not when we were using QEMM. Moreover, QA/DOS offered no information on file handles or software interrupts. And although it successfully located a sound board, it reported that no scanner was present on a system with an HP ScanJet Plus.

LIKE-NESS

QA/WIN provides a variety of system information similar to the reporting part of QA/DOS. In addition, it tests and reports on multimedia hardware, but the sound board test looks only at whether the system can play WAV and MIDI files).

While QA/WIN provides some system information that's not available in QA/DOS, including software interrupts, it fails to report on programs loaded high under DOS 5 or DOS 6.

The information reported in the Windows version is poorly organized. For example, you can access video driver information only by going through two menu buttons. Worse, the information given is often not the most important. There is considerable detail about individual Windows applications (including the size of the code and data modules) but not the two key pieces: the total amount of memory the application uses and how much of it is discardable.

QA/WIN makes poor use of the Windows interface. Almost all the modules open up a second window that must be closed before regaining access to the main window. The help button is located in the main window, so if you're confused in the second window, you're out of luck.

While QA/DOS contains performance tests for video, disk, and CPU, QA/WIN has only a disk performance test. This and some of the diagnostic tests can take quite some time, yet there's nothing either before or during the tests to indicate how long.

The Windows package has a Windows version of the file compare function as well as a simple file editor. It also includes a virus check and a FaxModem test module from BitFax. Bundled with both the DOS and Windows packages is the host half of the ReachOut remote control software, which lets DiagSoft's technical staff dial into and control your computer.

QA Plus (for DOS) and QAPlus/WIN are competent products but do not stand up to any of the competition.

▶ FACT FILE

QA Plus Version 4.7 and
QAPlus/WIN, Version 5.1
DiagSoft, 5615 Scotts Valley Dr., #140, Scotts Valley, CA 95066; 800-342-4763, 408-438-8247; fax, 408-438-7113.
List price: *$159.95 each.*
Circle 458 on reader service card

Watergate Software Inc.

µPC-Doctor

The $129.95 µPC-Doctor, Version 1.0, from Watergate Software is a solid DOS-based performer that, like CheckIt PRO: SysInfo, reported only accurate information for our test systems.

µPC-Doctor located the sound cards and properly identified their IRQs. The program correctly reported which systems had 16550 UARTs on their serial ports and which the older 16450s. It also successfully reported programs loaded high under DOS 5, DOS 6, and QEMM.

µPC-Doctor looks for and reports on drives compressed with Stacker. The version we looked at did not support drives that were compressed with DOS 6's DoubleSpace, but a DOS 6 upgrade should be out before you read this.

CALL THE DOCTOR

µPC includes an extensive suite of diagnostics, but the tests report only whether the system passed or failed with no indication of why or where. There are benchmark tests for the CPU, memory, video, and hard disk, but the reports include only raw numbers with no external comparison data of the kind found in CheckIt PRO.

µPC-Doctor looks for IRQ and DMA conflicts but does not report I/O ports or DOS file handles.

While the reporting was accurate, we did run across one program glitch. With QEMM installed in Stealth mode on our complex test system, µPC-Doctor crashed during the IRQ/DMA usage test. Using HIMEM instead of QEMM eliminated the problem.

While µPC-Doctor has drop-down menus and attractive text-mode boxes, the interface is, in some respects, rather bare-bones. All the information in a report is dumped into a single scrolling text box. For example, the memory information report includes overview, program information, BIOS data, and the DOS environment (what you see when you type "set" at the DOS prompt); so locating what you want can be difficult.

Watergate bundles TNT Antivirus (scanner only), a public domain virus checker from Systems Security Technology, with the package.

▶ FACT FILE

µPC-Doctor, Version 1.0
Watergate Software Inc., 2000 Powell St., #1200, Emeryville, CA 94608, 510-596-1770; fax, 510-653-4784.
List price: *$129.95*
Circle 459 on reader service card

Landmark Research

Landmark SysInfo
WinProbe

Landmark Research's $99 WinProbe (for Windows) and its $69 Landmark SysInfo (for DOS) attempt to provide a number of unique services and pieces of information that make them potentially attractive products. But both of these programs have so many problems and make so many errors that they fail to realize this potential.

µPC-Doctor is a solid DOS-based performer that, like CheckIt PRO: SysInfo, reported only accurate information for our test systems.

WinProbe has the most problems. Running the System Information command on our complex test-bed system caused a protect mode violation. The vendor conjectured that this was a QEMM conflict, but it remained when HIMEM was used as the memory manager.

There is questionable information on the main screen: the free system resources and the memory numbers differed from those provided under the Help/About Program menu in Windows' Program Manager. The vendor said that the resource problem was due to the fact that WinProbe's code for that item had not been updated since the release of Windows 3.1. The memory numbers differ because Program Manager includes discardable memory that Windows can use. Landmark offered no convincing reason as to why it chose not to follow the Windows convention.

A lovely idea in the program is its ability to check out your *.INI files and your Program Manager groups for references to nonexistent files. Once you know what they are, WinProbe suggests that you remove these references. But in some situations the method used to parse out filenames was faulty. Microsoft Word for Windows, for instance, uses a syntax for its import filters in the WIN.INI file which confuses WinProbe so much that it claims the filters do not exist.

Furthermore, if the properties dialog for a Program Manager item shows a working directory different from the path to the executable, WinProbe again claims a file doesn't exist. Since WinProbe suggests removing any program icons for which it cannot find the file, this is a serious glitch. The program even reported a negative number of free EMS pages!

It is unfortunate that WinProbe is so error prone because it provides a fair amount of useful information: most IRQ, DMA and I/O port details, lots of Windows system metrics, and the basic DOS and hardware information. But since you rely on a reporting program for accurate information, WinProbe is definitely not ready for prime time.

LANDMARK SYSINFO

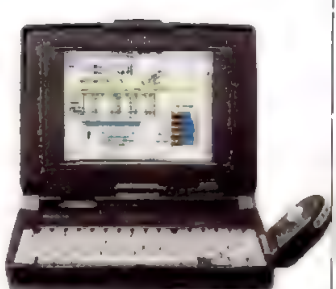
Landmark SysInfo fares better, but it too was tripped up by our complex system. Loading SysInfo crashed the system. Landmark's technical support said that this was a conflict with local bus video and told us how to turn off the video test to load SysInfo successfully.

The program provided information that some of the other programs didn't: the bus type (ISA, EISA or MC), and, on the simpler system, the motherboard and video chipsets. And on the complex system it located the advanced 16550

Hundreds Of Companies Can Sell You A Computer Through The Mail.

BUT THERE'S ON
THAT CAN DE

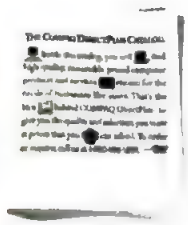
Announcing COMPAQ DirectPlus, a way for you to get the quality and reliability Compaq is known for, through the convenience of buying direct. We offer popular COMPAQ PCs and the industry's leading software, all at competitive prices—the kinds of products you've asked for based on your computing needs. That's the idea behind COMPAQ DirectPlus: to deliver the quality and flexibility you want, without expanding your budget.



Known for quality and reliability, Compaq offers you some of the best-engineered computer products in the industry—at very attractive prices. Everything from innovative notebook PCs to versatile desktops.

LY ONE COMPANY LIVER ALL THIS.

As an industry leader, our alliances with leading software companies let us offer you a full selection of the most popular software, everything from word processing and spreadsheet to database and presentation graphics.



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Our service and support options offer everything from on-site installation by a Compaq-authorized technician to on-line diagnosis of technical problems on your PC.

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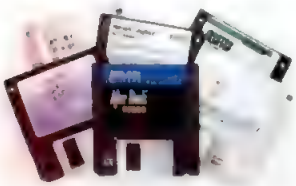

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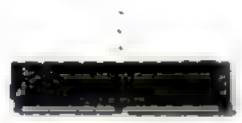

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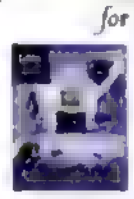

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CIRCLE 137 ON READER SERVICE CARD

UART chips attached to the COM ports.

SysInfo found the Sound Blaster card but failed to identify its associated IRQ. It reported that the system with a SCSI controller had none and also claimed that the fourth hard disk partition was a RAM drive!

The DOS information it gives is thin: no reports on open files, last drive, or the environment. And SysInfo has no reports on I/O ports or DMA channels.

The strongest part of SysInfo is its help and tutorial information, which includes items like the meaning of the POST error codes from the major BIOS suppliers.

▶ FACT FILE

Landmark SysInfo and WinProbe
Landmark Research, 703 Grand Central St., Clearwater, FL 34616; 800-683-6696, 813-443-1331; fax, 813-443-6603.
List price: *Landmark SysInfo, $69; WinProbe, $99.*
Circle 461 on reader service card

Dariana Software

System Sleuth Professional
WinSleuth Gold

Dariana Software's $169 WinSleuth Gold also includes the company's DOS System Sleuth Professional that for the most part is no longer sold separately. After a few shaky releases in which the company relied on outside developers, Dariana shifted to in-house development and produced a solid Windows reporting tool. Bundled with WinSleuth Gold is WIN Rx, a virus detection and removal program from Trend Micro Devices Inc.

WinSleuth Gold is notable for graphics. The IRQs, DMA, and I/O ports submenu has an animated graphic of a board being installed.

WinSleuth is driven entirely from a button-bar interface that offers choices for system, environment, disk, video, ports, memory, installation, report, tune-up (which advises you on what changes to consider making in your four basic system files) and control (to customize the program). The program has impressive-looking graphics, but they add nothing to the product's functionality. We also looked at System Sleuth Professional and a beta version of WinSleuth Gold Plus.

WinSleuth Gold Plus has the most spectacular bitmapped graphics we've seen in a utility.

SLEUTHING

WinSleuth Gold gives you a wealth of detail—from the properties of the Windows video and printer drivers to the hard drive parameters. There are two areas where we wish it provided more information, though: memory used by applications and disk space used by directories.

WinSleuth does report total memory used by Windows applications under the Memory field, but it gives you only an application-by-application breakdown under Open Files in its Environment field. On systems with less memory, a report on how much an application is using and how much is discardable would be invaluable.

The package reports percentage disk usage by directory. But on systems that have lots of directories, the presentation is not very informative. Listing disk usage by file type and pinpointing directories with no recent file activity could also be useful. (We should emphasize that none of the other programs reviewed provides that kind of data. We wish they all did!)

DOS DETECTIVE

System Sleuth Professional, the DOS program, has a text-mode windowed interface. Except for Windows information, it provides the same wealth of detail as WinSleuth.

Both WinSleuth and System Sleuth Pro report on DMA and IRQ usage. They also report on I/O ports, correctly warning you that sending bits to I/O ports in use could hang a system. Both test only small user-selected ranges.

We encountered only a few glitches during our tests. On the high-end test system, each of the two physical hard drives had two partitions, but when WinSleuth Gold reported on partition information, it claimed that one physical drive had three logical drives and the other had only one. Dariana is aware of the problem and expects to have it fixed by the time you read this. Remarkably, System Sleuth Pro didn't make this mistake. The beta we saw of WinSleuth Gold Plus also showed the right information. On our simpler system, however, System Sleuth Pro claimed there was a VGA adapter *and* an MDA (monochrome) adapter, though there was only a VGA card.

We saw an early beta version of WinSleuth Gold Plus. Not only did it have the most spectacular bitmapped graphics that we've seen in a utility, but it will also introduce a standard that, should it be adopted, could radically simplify board installation. Under this standard, board vendors will ship special DLL software with their boards; this software will contain graphical schematics and port information that links to WSG Plus. If your motherboard maker provides such a DLL, you will be able to bring up a detailed schematic of the board and, for example, see the location of any bad memory chips. It's not clear whether a small company like Dariana Software can rally the industry, but if it can, the results could help us all.

▶ FACT FILE

WinSleuth Gold and
System Sleuth Professional
Dariana Software, 5241 Lincoln Ave., Suite B5, Cypress, CA 90630; 800-892-9990, 714-236-1380; fax, 714-236-1390.
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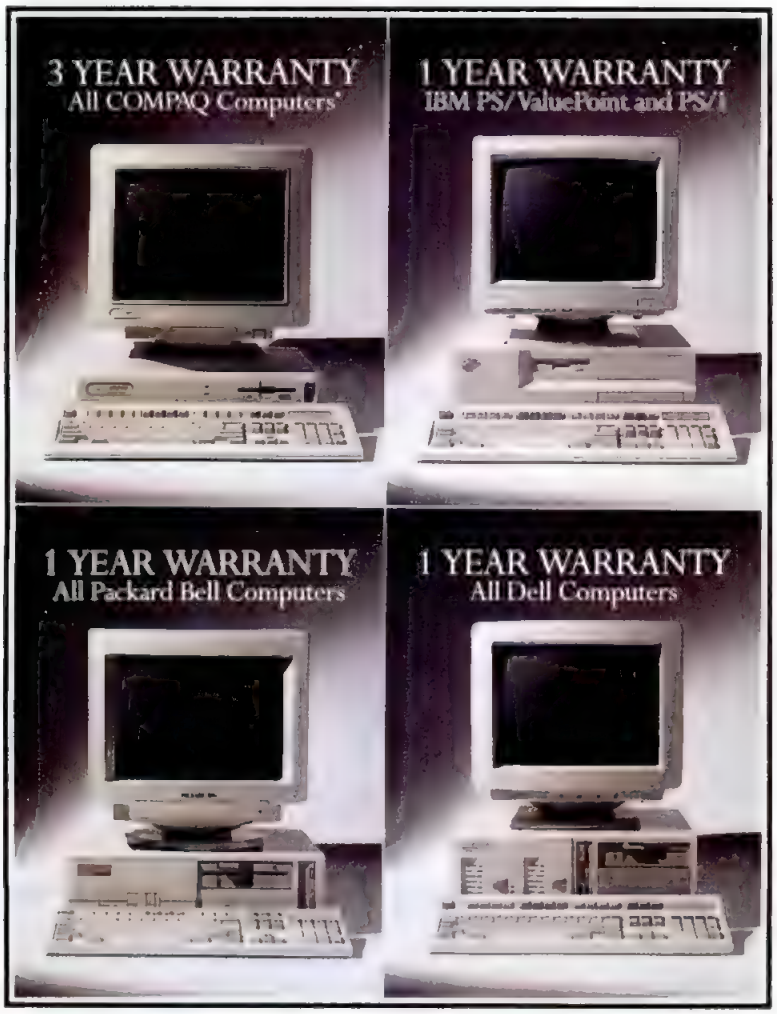

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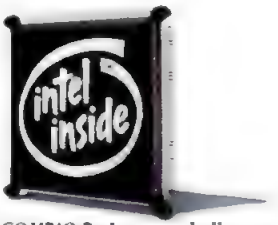

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CIRCLE 240 ON READER SERVICE CARD

SERVICE & RELIABILITY

Satisfaction Amid Change

by Robert Calem and Michael J. Miller

Whose PCs are most reliable? Who has the best repair service? The best technical support? Over 8,700 readers rate PC and laptop vendors.

Competition in the PC marketplace has never been quite as fierce as it has been in the past year. Machines are faster than ever, and prices have dropped even faster. Vendors are trying new channels of distribution, new support and service policies, and in many cases, smaller margins. Some vendors have thrived under this competition; others have folded their tents.

Despite the volatility in the market, most *PC Magazine* subscribers remain very satisfied with the reliability of the desktop systems they use, along with the quality of repair service and technical support they have received. Yet the most recent of our semiannual surveys of service and reliability continues to point out wide differences in service and reliability among different vendors and shows an overall decline in the perceived reliability of laptop systems.

Photography by Jeffrey Krein

HIGHLIGHTS

Service & Reliability: PCs

SERVICE AND RELIABILITY are important differentiators of desktop and laptop PC vendors. To measure how users assess these areas, *PC Magazine* surveyed 17,000 readers in late winter and received 8,716 responses. Our survey results cover 36 desktop and 20 laptop vendors. Levels of satisfaction were generally high, although they slipped slightly from similar surveys we published in our issues of May 26, 1992, and February 9, 1993.

SURVEY QUESTIONS covered reliability, satisfaction with repair experience, satisfaction with technical support, and the likelihood of buying again from the same vendor. We tabulated the results and determined whether each vendor's score on each measure was average, significantly above average, or significantly below average. Based on the responses to the first three questions, we assigned each vendor an overall ranking of excellent, above average, average, below average, or poor.

AMONG DESKTOP PCs, eight vendors received overall rankings of excellent, indicating that they scored significantly above average on all three key measures. Seven of them sell primarily by mail: Austin, CompuAdd, Dell, Gateway 2000, Northgate, Swan, and Zeos. Compaq is the eighth vendor.

SIX OTHER DESKTOP PCs vendors were ranked above average, with individual scores of average or better. They are AST, DEC, Hewlett-Packard, IBM, NEC, and Tri-Star.

AMONG LAPTOPS, readers rated five portables as excellent. Compaq and Zeos again placed in the top tier and were joined by Dell, IBM, and Toshiba. Apple and AST were rated above average. We included Apple in our survey because many PC users have Apple systems as well.

SERVICE AND RELIABILITY data is obviously historical in nature. Vendors cannot improve the reliability of systems that are already built. Yet several vendors have dramatically improved their satisfaction scores by expanding customer-direct telephone support and adding support staff.

As in past studies, we surveyed 17,000 of you readers, selected at random from our subscriber roles. On a scale of 1 (lowest) to 10 (highest) we asked you to rate the reliability of the PCs you used most in the past two years, as well as your satisfaction with technical support. On the same survey, we asked you to rate your repair experience and to indicate how likely you were to buy from the same manufacturer in the future. We heard from 8,716 of you from January 22 to March 5 of this year, for a 52 percent response rate (after we excluded 105 surveys that were not delivered by the post office). We decided to include only vendors that received at least 50 responses in the final tabulations, to ensure that the results are statistically significant. This left us with ratings of your satisfaction with reliability, service, and support regarding 36 makers of desktop systems and 20 vendors of laptop or portable systems.

As in past years, most readers reported a high degree of reliability in most desktop and laptop systems. Reliability scores for desktop systems ranged from a high of 9.1 for high-flyer Gateway 2000 to a low of 7.1 for Memorex Telex, which is no longer a major player in the market. With laptops, we found a somewhat tighter range of reliability scores, from 8.8 for Compaq, IBM, Toshiba, and Zeos to a low of 7.3 for Bondwell. The average reliability score for all vendors was quite high, though: 8.3 for desktop and 8.2 for laptop systems.

Satisfaction with service and support, however, was not as high. Satisfaction with repair service came in at 7.7 for desktop vendors and 7.0 for laptop vendors. Similarly, satisfaction with technical support was 7.3 for desktops and 7.0 for laptops.

Most of these scores are down slightly—0.1 to 0.2 points—from the surveys we conducted some 6 and 12 months ago, with laptop scores having declined a bit more than desktop scores. For more information, see "How Good Is Your PC?" (*PC Magazine*, February 9, 1993) and "How Reliable Is Your PC Vendor?" (*PC Magazine*, May 26, 1992).

DESKTOP LEADERS

As in past surveys, we have ranked the vendors according to how the readers rated each in reliability, quality of repair service, and quality of technical support. Our "Readers' Choices" in the Service and Reliability survey are those vendors that scored significantly better than average in all three of these categories.

We also asked about readers' likelihood of purchasing another PC from the same vendor, but we do not include this measure in our composite ranking because it may reflect other factors such as price, performance, availability, and the vendor's perceived stability.

In this study, eight vendors of desktop systems wound up in the top tier. Dell, Gateway 2000, Northgate, Swan, and Zeos repeated their appearance in this ranking from our previous survey. They were joined at the top by Austin, Compaq, and CompuAdd.

Note that seven of these eight top-scorers are known primarily as direct vendors, although Dell has branched out to retail distribution in recent years. The lone exception is Compaq, which primarily sells through resellers, although it has recently moved into the direct channel.

Compaq's place among the leaders is a testament to what happens when a company puts strong technical support policies into place. In December, Compaq began offering a three-year warranty that includes a promise of on-site service for the first year at no additional cost. That followed an expansion of its technical support

Our Contributors: MICHAEL J. MILLER is editor-in-chief of *PC Magazine*. ANUSH YEGYAZARIAN is an editorial researcher at the magazine, and ROBERT CALEM and PEGGY WATT are contributors to *PC Magazine*.

hot line from 12 hours a day Monday through Friday to round-the-clock service seven days a week.

Austin's efforts to enhance customer satisfaction have been even more dramatic. The company made significant improvements in its operation, adding six people to the staff of its technical support hot line since last October, including three assigned to provide high-level support to customers with complex problems. Additionally, tech support staff have been given 1 to 2 hours of training every week since last summer. To improve reliability, Austin rebuilt its manufacturing plant this year to increase efficiency and capacity, added a hot line for field service personnel to call with questions, and replaced General Electric with Data General as its on-site service provider.

Although Gateway 2000 has received a fair amount of publicity about problems in reaching technical support, it appears in the top tier for the third straight survey, showing particularly impressive scores for reliability and quality of repair service. Part of that may reflect Gateway's internal response to customer complaints about difficulties in getting through to technical support. Since our last survey, the company added technical support associates to its hot line staff.

The second group of vendors scored above average overall by receiving one or two scores that were significantly above average (but not all three). These six are AST, Digital Equipment Corp., Hewlett-Packard, IBM, NEC, and Tri-Star. Except for DEC, these six vendors were all rated significantly above average on reliability. AST and DEC had been in the top tier in our previous reader survey. AST's scores for satisfaction with repair experience and technical support slipped from significantly above average into the average group. DEC's score for satisfaction with repair experience also slipped to the average level.

Tri-Star moved up into this second tier because of its significantly above-average scores for reliability and satisfaction with technical support, an improvement from the average score it received on these two measures in our last survey.

Several other vendors also moved up in the rankings. NCR moved into the average group, having received average scores on all three measures, compared with the below-average scores it received for reliability and satisfaction with technical support last time. ALR, which also received average scores on all three measures, had previously posted below-average scores for satisfaction with repair experience and technical support.

Acer climbed a notch to average scores for both reliability and satisfaction with repair experience. But it still garnered a below-average score for satisfaction with technical support. Acer says it beefed up its phone system and hired more support technicians earlier this year. Hyundai also left the lowest-rated group, receiving average scores for satisfaction with repair experience and technical support. Still, Hyundai was dogged by a below-average score for reliability.

AT&T, Leading Edge, Packard Bell, Tandy, Wyse, and Zenith Data Systems scored in the bottom tier among desktops. All received lower-than-average scores in all three key measures, with Leading Edge and Packard Bell both showing drops from our previous study.

What do the five lowest-rated vendors have to say for themselves? Except for Packard Bell, old 8088- or 286-based systems constituted more than half of their PCs in our survey (versus 29 percent overall); some vendors, particularly ZDS, cited that as a possible factor. We informally analyzed service and reliability for the lowest-rated vendors' newer PCs (486DX and 486SX systems) against the survey average. Because of the small samples, it was difficult to draw conclusions for any vendor other than ZDS, whose scores remained below average.

ZDS also noted that more than a quarter of its systems have been sold to the government and military, and many of them were sold under a contract that awarded the service and support contract to a third-party supplier. ZDS says that last year it introduced improved technical support and a telephone hot line.

AT&T's PC operations were absorbed in 1991 by NCR (which is rated average). Even though the equipment is late in its life cycle, an NCR spokesman says, the low ranking is "not acceptable." Leading Edge says that since the beginning of the year, it has increased the number of tech support staff and the size of its parts inventory by more than one-third. Leading Edge added new warranty

READERS' CHOICE

- **Desktop vendors: Austin, Compaq, CompuAdd, Dell, Gateway 2000, Northgate, Swan, and Zeos**
- **Laptop vendors: Compaq, Dell, IBM, Toshiba, and Zeos**

The winners of Readers' Choice status are vendors that our readers rated significantly above average on all three key measures of our survey: reliability, satisfaction with repair experience, and satisfaction with technical support.

Austin, Compaq, and CompuAdd joined previous winners Dell, Gateway 2000, Northgate, Swan, and Zeos in the desktop category. Newcomers Dell, IBM, and Toshiba joined previous winners Compaq and Zeos in the laptop category.

Other computer vendors that fared well in this survey include AST, DEC, Hewlett-Packard, IBM, NEC, and Tri-Star in the desktop category and Apple and AST in the laptop category. These companies all received a mix of average and significantly above-average scores in our service and reliability survey, placing them in the second-highest tier in terms of reader satisfaction.

options: a two-year warranty with carry-in service or one year with on-site service. Packard Bell, the only one of the bottom six without a significantly disproportionate number of older PCs, says it introduced a newer, more reliable line of systems in late winter and provided more in-the-box information on how to hook up the systems. Packard Bell also says it hired 100 additional support technicians this year.

A Tandy spokesman said only that he was surprised at the negative impressions readers had about Tandy PC products. A Wyse spokesman said that his company has shifted to using Hewlett-Packard to provide on-site support, and Wyse now provides HP technicians with repair kits containing 30 parts that allow technicians to resolve 90 percent of service issues.

WOULD THEY BUY AGAIN?

Happy customers tend to be repeat customers, but perceptions can have as much impact as hands-on experience when users actually choose what system they will buy. That is why we looked at users' likelihood of buying another system from the same company as a separate index from the three key measures in our survey.

Vendor performance on this index does not always parallel the data on service and reliability. Factors that are not so easily measured—how buyers perceive a company's performance, current market activity, customers' confidence in the company's future, and how they perceive its long-term likelihood of supporting the systems it sells—frequently affect buying decisions.

For instance, Northgate's score in this area dipped a bit from last year, but not enough to slip out of the significantly above-average group. And its customers still rated the Minnesota-based company significantly above average in reliability, service, and support. Although Northgate changed ownership and underwent layoffs last year, it maintained its 24-hour, seven-day-a-week tech support lines.

Two of the very largest PC vendors, Compaq and IBM, have made significant improvements in their service, support, and pricing policies. Their

Hardware and Software Ratings

How We Surveyed

In January 1993, we mailed questionnaires to a random sample of 17,000 *PC Magazine* subscribers. The survey was closed on March 5, 1993, by which time we had received a 52 percent response. The data in this report and the report on software that follows is based on the responses in the 8,716 questionnaires returned to us, as tabulated by Willard & Shullman, a research firm based in Greenwich, Connecticut. (105 questionnaires were not delivered by the post office.)

In the questionnaire, we asked subscribers to describe each of the desktop and laptop or notebook PCs they had used over the past two years, telling us the manufacturer and chip type of each. Next, on a scale of 1 (worst) to 10 (best), respondents rated the reliability of each PC, their satisfaction with the repair service, and their satisfaction with the technical support they had received. Respondents also indicated the average number of days each PC was unusable because of hardware, technical support, or repair problems; which components, if any, needed repair; and their future likelihood of buying from the same vendor.

We also asked subscribers to indicate which specific software packages they use most often (word processing, spreadsheet, database, and graphics packages, as well as operating systems/environments) and to rate their satisfaction with each package on a scale of 1 to 10. Subscribers rated their satisfaction with each package's overall technical support—and with a number of specific types of support. The relative importance of each type of support in subscribers' ratings of software satisfaction was also evaluated.

MAKING SENSE OF THE RESPONSES

To analyze the results, we focused on one measure (survey question) at a time and calculated a mean average score for each PC manufacturer or software package. (Only vendors that received at least 50 responses—the minimum amount of data required for meaningful results—were included in the final tabulations.) As a standard of comparison, we obtained an overall average for each measure by adding the individual averages and dividing by the number of companies or products rated. Thus, we obtained an average score that is not weighted by market share; each PC manufacturer or software package contributes equally.

STATISTICAL METHODOLOGY

Statisticians who are curious about our methodology should know that the differences cited in this report were evaluated using a standard t-test for means. Such a test is made up of the following components: the scores, the amount of dispersion in the scores, and the sample sizes. Scores were considered to be different from one another if the difference was statistically significant at the 95 percent confidence level. This means that if we were to conduct the same study in exactly the same manner 100 times, we could expect the differences reported here to appear at least 95 times. Our procedure provides a high degree of confidence that the differences are not due to chance or error.

T-tests can sometimes produce anomalous results where two scores that appear close together may in fact be significantly different from one another. T-tests can also reveal no statistically significant differences between two scores that seem far apart from one another. In fact, it is possible for one product to appear in the average range while another with the same score emerges as significantly above average. These results are a function of the objective, evaluative components of a t-test for means.

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B 05068	Canon BJ-10e/Apple StyleWriter Ink Refill Blk 2pk	$14 98
B 09735	Canon BJ-10EX Bubble Jet Printer Black	$28"
B 09823	Colorado Jumbo 250 TBV	$214
B 05711	Fuji 3 5 MF 2HD Bulk Unformated	$58 98
B 12116	Hercules Computer Graphite HG210	$298
B 09522	Kensington Expert Mouse	$98 98
B 06421	Kensington Micro Saver System	$49 98
B 04690	Kensington NoteBook Traveler Deluxe Case	$"8 98
B 06512	Kensington NoteBook Traveler Executive	$112
B 10662	Maxtor MXT "213A 213 omb IDE Int HD 15MS	$408
D 08620	Microsoft Serial Mouse and PS/2	$86 98
W 11931	Microtek ScanMaker II	$8"8
W 11930	Microtek ScanMaker II XE	$1,098
D 11530	NEC CD Express PC w/CDR 25	$349
B 06722	NEC Multispin CDR "4-1	$636
B 99801	NEC Multisync 15 Monitor 4FGe	$629
B 07399	NEC Multisync 1" Monitor 5FG	$1,398
B 99990	NEC Multisync 1" Monitor 5FGe	$1,188
B 053"5	NEC SilentWriter (Toner Cartridge Model 95)	$1"4
B 06"01	NEC SilentWriter M95F	$1,349
B 05521	Pantone Process Color Imaging Guide 1000	$61 98
B 04056	Pantone Process Color System Guide	$54 98
B 08228	1MBx9 - 80ns	$49 98
B 06280	PowerPoint Laser Light Pointer	$98 98
B 06552	PrecisionColor Pivot	$998
B 10568	Pro Audio Spectrum 16	$198
B 11129	Remote Power On/Off	$118
B 02192	Sony 3.5 Floppy Disk 2HD 10 PC Pack	$15.98
B 08404	Sony 3 5 Rewrite M O 512 Byte/Sec 128 MB	$59 98
B 08415	Sony 5 25 Rewrite M O 512 Byte/Sec	$135
B 12129	Sound Blaster 16 ASP	$239
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B 06023	Targus Notepac Case Black	$35 98
B 05284	Targus Premier Leather Notebook Case	$138
B 07454	Targus Universal Notebook Case	$68 98
B 04096	TI PS 1" Laser W/Apple Talk	$1,198
W 06499	Timbuktu/Win PhoneNET Kit	$2"5
B 12035	Trakker 250	$428
W 10514	Ulima Home Office	$294
B 10"28	Video Blaster Bundle	$344
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W 11300	Win/TV	$438

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B 09064	Advanced Gravis Joystick - Black	$36 98
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B 11240	Creative Labs Multimedia Upgrade Kit Int	$564
B 12181	Haves ACCURA 24 Ext	$82 98
B 12182	Haves ACCURA 96 + FAX 96 Ext	$248
B 07216	Logi Kidz Mouse	$39 98
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B 0"182	NEC Multisync 21 6FG	$2,698
B 03691	PLI CD-ROM HD	$5"9 00
B 03339	Power Tree 10	$1" 98
B 03343	Power Tree 50	$45 98
B 11938	PowerBacker Plus 300	$2"8
B 11939	PowerBacker Plus 450	$358
B 04491	Shiva NetModem E Thin/BNC	$1,4"8
B 06234	SuperMatch 20 T Multimode Trinitron Clr Dsply	$2,698
B 11986	Sydos Puma 8	$498
B 05442	SyQuest 44MB Cartridge 5 Pack	$328
B 08915	TEAC 14MB 3 5" Floppy Drive	$59 98
W 11827	Thunder 24 Etsa	$2,188
B 04313	TI PS 35 Laser w/Apple Talk	$1 328
B 00409	TI PS 35 MicroLaser Turbo Printer	$1,598
B 03666	TI Toner Kit	$42 98

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W 11903	Adobe Photoshop 2.5 for Win - D	$548	
W 07787	After Dark 2.0 for Windows - D	$28.98	
W 08058	Aldus PageMaker 5.0 - 3"	$579	
W 11912	Aldus Persuasion 2.1 Comp Upgr - 3"	$94.98	
B 07826	Borland C++ 3.1 - 3"	$328	
W 11560	CorelDraw 3 - 3"	$138	
D 08886	Design Your Own Home Architecture - D	$32.98	
W 11328	FileMaker Pro 2.0 for Win Upgrd - D	$122.95	
W 07475	Fractal Painter 2.0 for Windows - 3"	$258	
W 11188	FrameMaker 3.0 for Windows - 3"	$498	
W 07481	FreeLance 2.0 Comp Upgr - 3"	$98.98	
W 09868	Lotus 1-2-3 for Windows 1.1 - 3"	$308	
D 07149	Lotus 123 3.4A Upgrade - 3"	98.98	
W 12397	Lotus 123 5 for Windows Upgrade - 3"	98.98	
W 09725	Lotus Ami Pro 3.0 Competitive Upgr - D	$94.98	
W 12015	Lotus Improv for Win - 3"	$89.98	
W 11193	Lotus Organizer for Win - D	$98.00	
W 12102	MS Access 1.0 Competitive Upgr - 3"	$188	
W 07497	MS Bookshelf for Win - C	$128	
D 12226	MS DOS 6.0 - 3"	$39	
W 11978	MS Encarta - C	$248	
W 07895	MS Excel 4.0 Competitive/Version Upgr - 3"	$118	
W 11886	MS FoxPro 2.5 Windows Competitive Upgr - 3"	$188	
W 12153	MS Office 3.0 Comp/Ver Upgr - 3"	$128	
W 07209	MS PowerPoint 3.0 for Windows Comp Upgr - 3"	$118	
W 12147	MS Printing System for Win - D	$128	
W 12027	MS Profit - 3"	$128	
W 07610	MS Project 4.0 for Win - D	$448	
W 09760	MS Publisher for Windows - D	$128	
W 11878	MS Visual Basic Pro 2.0 Comp Upgr - 3"	$198	
W 07752	MS Windows 3.1 - 3"	$89.98	
W 07404	MS Word 2.0 for Windows Comp Upgr - 3"	$128	
W 09763	MS Works 2.0 for Windows - D	$128	
W 07834	Norton Desktop for Windows 2.2 - 3"	$114	
D 07380	Norton Utilities 7.0 - 3"	$114	
W 11872	Paradox for Win 1.0 - D	$128	
W 12221	PC Tools 8.0 for Windows - 3"	$119	
W 11740	Pixar Typestry for Win 1.1	$184	
W 11145	Procomm Plus for Win - D	$94.98	
B 09707	QEMM 386 - 3"	$60.98	
W 11910	QuarkXPress 3.2 for Windows - 3"	$588	
W 11257	Quattro Pro for Win - 3"	$93.98	
W 09768	Quicken 2.0 for Windows - D	$38.98	
B 09851	Stacker 3.1 - D	$98.98	
W 12036	The Printshop Dlx for Win - 3"	$48.98	
W 11509	Visio for Windows - D	$198	
W 09577	WinFax Pro 3.0 - D	$78.98	
W 07011	WordPerfect for Win Comp Upgr - 3"	$98.98	
W 07012	WordPerfect Version 5.1 Upgr 5.2 - 3"	$98.98	

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W 09311	ABC Flowcharter for Win 2.0 - 3"	$298
W 07918	AceFile 2.0 for Win - 3"	$49.98
W 11556	AddImpact! - 3"	$94.98
W 11235	Adobe Type Set Value Pack - 3"	$48.98
W 07849	AutoSketch for Win - D	$178
W 07731	Carbon Copy 2.0 - D	$128
D 12138	ClarisWorks - 3"	$94.98
W 13000	CompuServe Memb Kit for Win - 3"	$26.98
W 12557	Corel ArtShow 3 Book - CD	$28.98
W 12593	Corel SCSI Software	$68.98
W 12556	CorelDraw 4	$388
W 11063	Direct Access for Win - D	$64.98
W 11907	Effects Specialist for Win - 3"	$108
D 12184	ElFish - 3"	$36.98
W 07458	Fasthack Plus for Win	$98.98
W 07480	Harvard Graphics for Windows 1.03 - 3"	$368
B 11902	Images w/Impact! CD ROM - C	$248
W 13001	infinType Plus - 3"	$54.98
W 11335	ManagePro 2.0 for Win - 3"	$238
W 12859	Morph 1.0 for Win - 3"	$98.98
W 12170	MS Visual C++ Pro Ed Ver Upgr - 3"	$134
W 11658	MS Win For Wrkstn Add On Starter Kit - D	$388
W 07750	MS Windows 3.1X 3.0 to 3.1 - 3"	$48.98
W 07868	New math Blaster Plus - D	$38.98
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W 13006	Publisher's Paradise Lite - 3"	$28.98
W 12513	Quicken Companion - D	$17.98
W 12512	Quicken for Win Business Pack - D	$59.98
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How Readers Rated PC Vendors

Readers rated desktop and laptop systems they had used in the past two years. Here we present the results for four key questions: overall reliability, satisfaction with repair experience, satisfaction with technical support, and future likelihood of buying from the same vendor. Respondents rated vendors on a scale of 1 (worst) to 10 (best).

We mailed 17,000 surveys and received 8,716 responses (a 52 percent

Overall Reliability

Significantly above average — Average — Significantly below average

0 1 2 3 4 5 6 7 8 9

Desktop Vendors

Acer	8.3
AGR	8.1
Apple	8.4
AST	8.5
AT&T	8.0
Austin	8.8
Compaq	8.8
CompuAdd	8.5
Compudyne	8.5
Dell	8.9
Digital Equipment Corp.	8.5
DTK	8.3
Epson	8.1
Everex	8.3
Gateway 2000	9.1
Hewlett-Packard	8.6
Hyundai	7.9
IBM	8.6
Leading Edge	7.8
Memorex Telex	7.1
NCR	8.1
NEC	8.6
Northgate	8.5
Packard Bell	8.1
PC Brand	8.2
Samsung	8.2
Swan	9.0
Tandon	8.0
Tandy	7.8
Texas Instruments	7.9
Tri Star	8.7
Unisys	8.0
Wang	7.9
Wyse	7.6
Zenith Data Systems	7.8
Zeos	8.8
Average	8.3

Laptop Vendors

Apple	8.4
AST	8.4
Bondwell	7.3
Compaq	8.8
CompuAdd	8.3
Compudyne	7.4
Dell	8.5
Epson	7.6
Everex	8.4
Gateway 2000	8.6
GRiD Systems	8.2
IBM	8.8
NEC	8.0
Packard Bell	7.8
Sharp	8.2
Tandy	8.0
Texas Instruments	8.1
Toshiba	8.8
Zenith Data Systems	7.8
Zeos	8.8
Average	8.2

WORST — BEST

Satisfaction with Repair Experience

Significantly above average — Average — Significantly below average

0 1 2 3 4 5 6 7 8 9

Desktop Vendors

Acer	7.3
AGR	7.8
Apple	7.8
AST	7.8
AT&T	7.2
Austin	8.5
Compaq	7.9
CompuAdd	8.0
Compudyne	7.9
Dell	8.5
Digital Equipment Corp.	8.0
DTK	7.8
Epson	7.5
Everex	7.6
Gateway 2000	8.6
Hewlett-Packard	7.9
Hyundai	7.1
IBM	7.9
Leading Edge	7.2
Memorex Telex	6.8
NCR	7.6
NEC	7.7
Northgate	8.1
Packard Bell	7.2
PC Brand	7.7
Samsung	7.5
Swan	8.4
Tandon	6.7
Tandy	6.7
Texas Instruments	7.7
Tri Star	8.3
Unisys	7.5
Wang	7.2
Wyse	6.9
Zenith Data Systems	7.0
Zeos	8.5
Average	7.7

Laptop Vendors

Apple	7.7
AST	7.6
Bondwell	6.2
Compaq	7.8
CompuAdd	7.3
Compudyne	5.9
Dell	7.9
Epson	6.2
Everex	7.6
Gateway 2000	7.6
GRiD Systems	7.0
IBM	7.9
NEC	6.2
Packard Bell	5.1
Sharp	6.6
Tandy	6.4
Texas Instruments	6.6
Toshiba	7.6
Zenith Data Systems	6.4
Zeos	7.9
Average	7.0

WORST — BEST

PC Vendors: Present and Past Rankings

Austin, Compaq, CompuAdd, Dell, Gateway 2000, Northgate, Swan, and Zeos rank highest among 36 desktop vendors in our Service & Reliability survey. Compaq, Dell, IBM, Toshiba, and Zeos rank highest among 20 laptop vendors.

We grouped the vendors in our surveys into five categories or tiers based on three key measures of service and reliability: reliability, satisfaction with repair experience, and satisfaction with technical support. (See the chart "How Readers Rated PC Vendors" for the component scores.)

These are the tiers:

- **Excellent** includes those that received significantly above-average scores on all three key measures of service and reliability.
- **Above average** includes those that received a combination of average scores and scores significantly above the average.
- **Average** includes those that received consistently average scores, or a combination of above-average and below-average scores.
- **Below average** includes those that received a combination of average and significantly below-average scores
- **Poor** includes those that scored significantly below average on all three measures.

Each vendor's name is followed by the number of pertinent reader responses we received In the current issue, we required at least 50 for the vendor to be included. Within each tier, vendors are listed alphabetically

This chart compares the current rankings with those we published in *PC Magazine*, February 9, 1993. We used the same questions and methodology both times.

DESKTOP SYSTEMS	*PC MAGAZINE*, JULY 1993		*PC MAGAZINE*, FEBRUARY 9, 1993	
		Responses		Responses
EXCELLENT	Austin	114	AST	585
	Compaq	504	Dell	723
	CompuAdd	517	Digital Equipment Corp	124
	Dell	938	Gateway 2000	1,300
	Gateway 2000	1,789	Northgate	365
	Northgate	353	Swan	93
	Swan	90	Zeos	464
	Zeos	548		
ABOVE AVERAGE	AST	651	Compaq	1,332
	Digital Equipment Corp	156	CompuAdd	467
	Hewlett-Packard	342	Everex	86
	IBM	1,004	Hewlett-Packard	300
	NEC	342	IBM	3,231
	Tri-Star	67	NEC	324
			Texas Instruments	49
AVERAGE	ALR	211	Apple	498
	Apple	609	Austin	88
	Compudyne	176	DTK	442
	DTK	446	Epson	332
	Epson	336	PC Brand	142
	Everex	396	Tandon	62
	NCR	126	Toshiba	166
	PC Brand	157	Tri-Star	61
	Samsung	105	Zenith	185
	Texas Instruments	51		
BELOW AVERAGE	Acer	197	ALR	231
	Hyundai	167	Leading Edge	358
	Memorex Telex	65	Memorex Telex	70
	Tandon	74	NCR	118
	Unisys	234	Packard Bell	679
	Wang	131	Wang	112
POOR	AT&T	317	Acer	165
	Leading Edge	372	AT&T	293
	Packard Bell	830	Hyundai	145
	Tandy	491	Tandy/GRiD Systems	425
	Wyse	162	Wyse	137
	Zenith Data Systems	708	Unisys	652
LAPTOP SYSTEMS	***PC MAGAZINE*, JULY 1993**		***PC MAGAZINE*, FEBRUARY 9, 1993**	
EXCELLENT	Compaq	703	Compaq	509
	Dell	284	Zeos	125
	IBM	232		
	Toshiba	875		
	Zeos	149		
ABOVE AVERAGE	Apple	222	CompuAdd	96
	AST	203	Dell	169
			Everex	56
			IBM	157
			Toshiba	745
AVERAGE	CompuAdd	131	Apple	70
	Everex	58	AST	145
	Gateway 2000	65	Epson	52
	GRiD Systems	89	Tandy/GRiD Systems	152
	Texas Instruments	126	Texas Instruments	73
BELOW AVERAGE	Bondwell	123	Leading Edge	48
	Epson	63	NEC	141
	NEC	165	Sharp	61
	Packard Bell	51		
	Sharp	65		
	Tandy	130		
POOR	Compudyne	73	Bondwell	88
	Zenith Data Systems	535	Zenith Data Systems	470

prices have become more competitive, and they've entered the direct channel. That was reflected in higher scores for the likelihood of buying again, although their rankings remain unchanged from six months ago: Compaq significantly above average, IBM significantly below average. Two companies with increases in their scores for the likelihood of buying again were Acer and Texas Instruments.

Companies with significant drops in this area included AST, Everex (which filed for Chapter 11 bankruptcy protection), Memorex Telex, and Tandon.

LAPTOP RATINGS

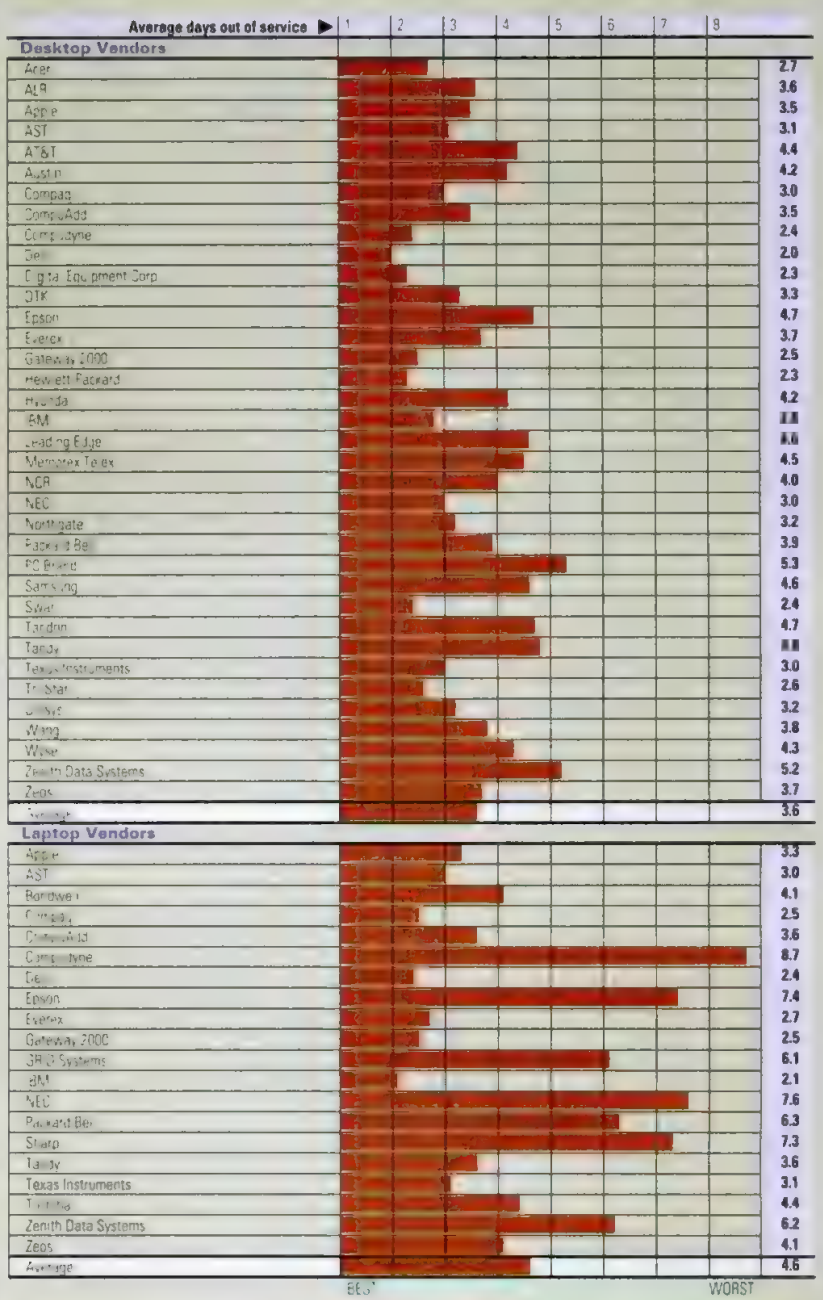
The scores were somewhat different among laptop vendors, where reliability showed a drop over the past year: 8.6 last May, 8.4 in February, and 8.2 this time. Compaq, Dell, IBM, Toshiba, and Zeos were the standouts here, receiving significantly above-average scores on all three key measures and placing in the first tier with an overall score of excellent. Apple and AST were in the second tier.

Compaq and Zeos repeated their top-tier laptop status from our last survey, but this time they had company. Toshiba joined their ranks after having been rated above average (the second-highest tier) in our previous survey. IBM was a newcomer among units with significantly above-average scores for reliability and satisfaction with repair experience. Big Blue also maintained a significantly above-average score for satisfaction with technical support. Dell, meanwhile, garnered a significantly above-average score for reliability—up from average—propelling it into the ranks of top performers.

Other improvements showing a mix of average and above-average scores were tallied for Apple's Macintosh line of Powerbooks and for AST. Both climbed to above average from average (the middle tier). We included the Apple machines in our survey because we found that a substantial number of *PC Magazine* readers use them. The Apple line's score for satisfaction with technical support advanced to above average, but it maintained average scores on the other measures. Likewise, AST amassed above-average scores for satisfaction with repair experience and technical sup-

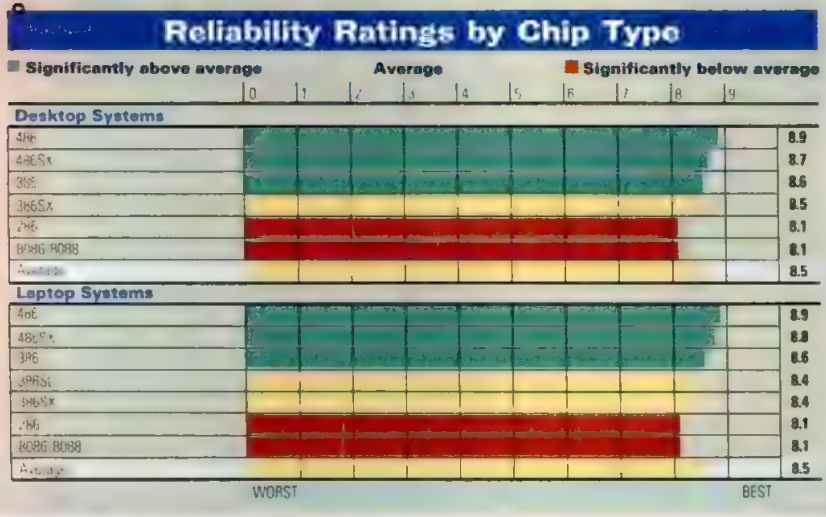
The Repair Record: Desktops Fare Better than Laptops

In general, vendors that emerged in the top tier (scoring significantly above average for overall reliability, satisfaction with repair service, and satisfaction with technical support) were among those with the best repair records; their systems tended to be out of service for the smallest number of days. Highly ranked vendors whose systems were out of service more than others included Austin, CompuAdd, Toshiba, and Zeos. Vendors with below-average ratings on all three key measures all had spotty repair records. Bear in mind that only readers who had experienced repairs or technical support problems responded to our question on this subject.



Chips Tell the Story: 386 and 486 PCs are More Reliable

Not surprisingly, readers were most satisfied with computer systems using 386 chips or better. Reliability and satisfaction ratings for various computer systems generally correlated with the microprocessors installed inside: Respondents rated systems with more recent, more powerful CPUs as more reliable in both laptop and desktop categories.



port but kept its average score for reliability.

CompuAdd, Everex, Gateway, GRiD Systems, and Texas Instruments laptops were in the average (middle) tier. CompuAdd and Everex had previously ranked above average, but CompuAdd's score for satisfaction with technical support has slipped, as have the Everex scores for reliability and customer satisfaction with repairs.

Six vendors fell into the below-average tier: Bondwell, Epson, NEC, Packard Bell, Sharp, and Tandy. Epson and Tandy had been in the average tier before, with both now indicating significantly lower-than-average satisfaction with technical support.

Finally, Compudyne and Zenith Data Systems ended up in the lowest group, with below-average scores on all three measures.

Note that ratings for laptop computers are often quite different from those for desktop machines. Note, too, that in laptops as in desktops, service and reliability are not necessarily the only indicator of whether the customers are likely to buy from the same vendor again. Yet all five of the vendors that rated in the top group for service and reliability—Compaq, Dell, IBM, Toshiba, and Zeos—are also above average for the likelihood of a future purchase.

LOOKING AHEAD

While you examine the scores of particular vendors in the accompanying charts, bear in mind that these are subjective results based on readers' perceptions and recollections about systems they have used during the past two years. Therefore, this survey reflects only the recent past, not the present or the future. Although a vendor cannot improve the reliability of systems that have already been sold, it can make changes to increase customer satisfaction with its technical support and repair services. Many of the vendors have made such changes, ranging from instituting toll-free support lines to extending their warranties. The current policies of 79 major vendors are summarized in the table "PC Vendors: Technical Support and Service Policies."

Elsewhere, we chart the average reliability of systems by chip type, and the average number of days systems have been out of service. This reflects on reliability, the capability of the repair service, and the availability of replacement parts.

We will continue to summarize these results in upcoming reviews of desktop PCs and notebook systems, and we plan to continue to survey our readers on a regular basis. The market is clearly evolving, and so is the support offered by vendors, along with our readers' perceptions of service and reliability.

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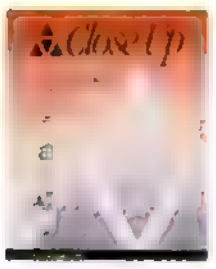

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PC Vendors: Technical Support and Service Policies

By Anush Yegyazarian **To supplement our reader survey on service and support policies, *PC Magazine* summarizes the desktop and laptop service policies of vendors that were covered in our reviews over the past seven months and that responded to our queries. This table covers mostly basic services and should serve as a comparative summary for potential buyers and as an update informing current users of recent changes in vendor policies.**

Companies listed in alphabetical order

■ = YES □ = NO

Company	Product lines	Type of machine	Dealers or direct-distribution channel	Standard warranty	Money-back warranty	Manufacturer's warranty worldwide	First-year on-site service charge	Subsequent on-site service charge	On-site service provider (and headquarters)
Acer	Acros, Power 486e	Desktop	Dealers	1 year	None	□	Included	1 year, $95; 2 years, $175	Olivette (WA), Xerox (Canada)
	AcerAnyWare	Laptop	Dealers	1 year	None	□	N/A*	1 year, $95; 2 years, $175	Olivette (WA), Xerox (Canada)
ACMA	486/33, 486/50, 486DX2/66	Desktop	Direct	1 year	45 days	□	Included	N/A	TRW (TX)
ALR	Evolution IV, Flyer, MPS, ProVEISA, Ranger	Desktop, laptop	Both	5 years parts, 15 months labor (1 year laptop)	30 days (through Prime Line Direct)	■	$9 95 (basic rate) (desktop)	Varies	Idea Servcom (AZ)
Altec	Altec 486	Desktop	Direct	2 years	30 days	■	Included	N/A	TRW (GA)
	Altec Notebook	Laptop	Direct	1 year	30 days	■	N/A	N/A	N/A
Altima	All	Laptop	Dealers	1 year	30 days	■	N/A	N/A	N/A
Amax	ISAmax, VESAmax	Desktop	Both	1 year	30 days	□	$89	N/A	TRW (TX)
American Mitac	Mitac	Desktop, laptop	Dealers	1 year	N/A	□	Included (desktop)	$99 per year	Dow Jones (NJ)
American Super Computer	All	Desktop	Both	2 years	30 days	■	Varies	Varies	Sequence (CA), GEAC (Canada)
Amrel	MLT486DXU	Laptop	Both	1 year	30 days	□	N/A	N/A	N/A
Aspen	486	Laptop	Both	1 year parts, 2 years labor	10 days	■	N/A	N/A	N/A
AST	Bravo, Premmia	Desktop	Dealers	3 years	N/A	□	Included	2d year, $59; 3d year, $99	Interlogic Trace (TX)
	PowerExec, PowerExec-EL	Laptop	Dealers	1 year	N/A	■	N/A*	N/A*	N/A
ATI	ATI-486	Desktop	Dealers	1 year	30 days	■	$99	10% per year*	Nationwide (CA)
Austin	Patriot	Desktop	Direct	2 years	30 days	■	Included	2d year, 1%, 3d year, 15%	GE (TX)
	Austin 4000	Laptop	Direct	2 years	30 days	■	N/A	N/A	Austin (TX)
Ault	Ace Cache 486V	Desktop	Direct	1 year	30 days	■	Included	$265 per year	IAI (CA)
Ares	486-VL	Desktop	Direct	2 years	60 days	■	Included	2d year, $75	GE (GA)
BCC	Avanti 425 C, 425 M	Laptop	Dealers	1 year	N/A	□	N/A	N/A	BCC (CA)
Bi-Link	All	Desktop	Direct	1 year	30 days	□	N/A	N/A	N/A
Blackship	All	Desktop, laptop	Direct	1 year	30 days	■	Included (desktop)	$45 per year	GE (GA)
C² Micro Systems	Saber	Desktop	Both	1 year	30 days	■	Included	$150 per year	IAI (CA)
	Pioneer	Laptop	Both	1 year	30 days	■	Included	$200 per year	IAI (CA)
CAF	AquaLITE, Platinum, Gold, Silver	Desktop, laptop	Dealers	1 year	30 days	□	N/A	N/A	N/A
Clover	All	Desktop	Both	1 year	30 days	■	$50	Varies	Clover (CA), Nationwide (CA)
Club American	Falcon	Desktop	Both	1 year	30 days	■	Included	$250 per year	GE (GA)
Compaq	All	Desktop, laptop	Both	3 years	30 days (through Direct Plus)	■ (Direct Plus, U.S. only)	Included	2 years, $77	GE (GA), Idea Servcom (AZ)
CompuAdd	Low Profile 425SLC, 433s/c	Desktop	Direct	1 year	30 days	■	$90	1 year, 10%; 2 years, 18%	Memorex Telex (TX)
	MC Series	Desktop	Direct	1 year	30 days	■	Included	1 year, 8%; 2 years, 15%	Memorex Telex (TX)
	Other desktops	Desktop	Direct	1 year	30 days	■	Included	1 year, 8%; 2 years, 15%	Memorex Telex (TX)
	325TX, 425C	Laptop	Direct	1 year	30 days	■	N/A*	N/A	N/A
CompuAdd Express	Desktop	Desktop	Direct	1 year	30 days	□	Included	386, $218/year; 486, $242/year	Hewlett-Packard (GA)
	Laptop	Laptop	Direct	1 year	30 days	□	N/A	N/A	N/A

N/A—Not applicable The company does not offer this service for the product * The company will send prompt replacements for defective portables This kind of warranty may have an additional cost

CONTINUES

Primary technical-support number	Technical-support hours (eastern time)	On-line bulletin board service	Remote diagnostics/ Fax-back	Repair service handled by manufacturer or third party	Shipping charges to plant paid by	Shipping charges from plant paid by	Overnight shipping cost	Dealer repairs authorized
800-445-6495	8:00 A.M.–10:00 P.M. M–F, 10:00–7:00 Sat	408-428-0140	□■	Manufacturer	Customer	Manufacturer	Varies	■
800-445-6495	As above	408-428-0140	□■	Manufacturer	Customer	Manufacturer	Varies	■
800-786-8998	10:00–9:00 M–F, 11:00–7:00 Sat.	510-651-1606	□■	Both	Customer	Manufacturer	$15–$50	□
800-257-1230	9:00–9:00 M–F, 10:00–4:00 Sat.	714-458-6834	■■ 10:00–3:00 Sat	Both	Customer	Manufacturer	Varies	■
800-255-9968	12:00–8:30 P.M. M–F, 1:00–6:00 P.M. Sat.	818-969-2683	□■	Manufacturer	Customer	Manufacturer	Varies	□
800-255-9968	As above	818-969-2683	□■	Third party	Customer	Manufacturer	N/A	□
800-356-9990	10:30–9:00 M–F	510-356-2456	□□	Manufacturer	Customer	Manufacturer	$10.50	□
510-651-8886	10:00–8:30 M–F, 11:00–7:00 Sat.	510-651-1606	□■	Manufacturer	Customer	Manufacturer	Varies	□
800-777-1688	11:30–8:30 M–F	None	■■	Both	Customer	Manufacturer	Free	■
800-654-5136	9:00–9:00 M–F	None	■■	Manufacturer	Customer	Manufacturer	Varies	■
800-882-6735	11:00–9:00 M–Sat.	None	□□	Manufacturer	Customer	Manufacturer	$50	■
800-472-3273	9:00–6:00 M–F, 11:00–4:00 Sat.	None	□■	Manufacturer	Customer	Manufacturer	Free	■
800-876-4278	24 hours, 7 days	714-727-4723	□■	Manufacturer	Customer	Manufacturer	N/A	■
800-876-4278	As above	714-727-4723	□■	Manufacturer	Manufacturer	Manufacturer	Varies	■
800-488-7776	11:00–8:00 M–F	None	□■	Both	Customer	Manufacturer	Free	□
800-752-4171	7:00 A.M.–1:00 A.M., 7 days	512-339-3582	□□	Third party	Customer	Manufacturer	Free**	□
800-752-4171	As above	512-339-3582	□□	Manufacturer	Customer	Manufacturer	Free**	□
800-234-2945	12:00–9:30 P.M. M–F 1:00–7:30 P.M. Sat.,	None	□■	Third party	Manufacturer	Manufacturer	Varies	□
800-322-3200	24 hours, 7 days	313-473-7656	■■	Both	Customer (after first 60 days)	Manufacturer	Free	□
800-827-4888	11:00–8:00 M–F	408-944-9002	□□	Manufacturer	Manufacturer	Manufacturer	Free	□
310-692-5345	11:00–8:00 M–F	None	□■	Manufacturer	Customer	Manufacturer	Varies	□
800-531-7447	11.00–8:00 M–F	None	■■	Manufacturer	Customer	Manufacturer	Varies	□
800-367-7794	11:00–9:00 M–F	None	□■	Manufacturer	Customer	Manufacturer	N/A	■
800-367-7794	As above	None	□■	Manufacturer	Customer	Manufacturer	N/A	■
818-369-3690	11:30–8:30, M–F	None	□■	Manufacturer	Customer	Manufacturer	Varies	□
800-925-6837	11:00–8:00 M–F	None	□■	Manufacturer	Customer	Manufacturer	Varies	■
800-388-3288	10.00–8.00 M–F	None	■■	Manufacturer	Customer	Manufacturer	Free	■
800-345-1518	24 hours, 7 days	713-378-1418	■■	Third party	Varies	Varies	Varies	■
800-999-9901	24 hours, 7 days	512-250-3226	□■	Both	Customer	Manufacturer	Varies	□
800-999-9901	As above	512-250-3226	□■	Both	Customer	Manufacturer	Varies	□
800-999-9901	As above	512-250-3226	□■	Both	Manufacturer	Manufacturer or customer	Varies	□
800-999-9901	As above	512-250-3226	□■	Both	Customer	Manufacturer	Varies	□
800-925-0995	9:00–9:00 M–F	512-219-2699	■■	Manufacturer	Customer	Manufacturer	Varies	□
800-925-0995	9:00–9:00 M–F	512-219-2699	■■	Manufacturer	Customer	Manufacturer	Varies	□

† Percentage of original system cost. ** If the customer uses an overnight service to send a unit for repair, the company pays for overnight shipping to return it

PC Vendors: Technical Support and Service Policies

Companies listed in alphabetical order

■ = YES □ = NO

Company	Product lines	Type of machine	Dealers or direct-distribution channel	Standard warranty	Money-back warranty	Manufacturer's warranty worldwide	First-year on-site service charge	Subsequent on-site service charge	On-site service provider (and headquarters)
Compudyne	Desktop, mini-tower	Desktop	Both	1 year	30 days	□	Included	N/A	Hewlett-Packard (OR)
	Slimnote, Subnote	Laptop	Both	1 year	30 days	□	$99	N/A	Hewlett-Packard (OR)
Comtrade	VESA Local Bus	Desktop	Direct	2 years	30 days	■	Included	$150 per year	Nationwide (CA)
Data Storage	DataStor	Desktop, laptop	Both	3 years	30 days	■	Varies	Varies	GE (GA)
Deico	Predator I, II	Desktop	Both	1 year	N/A	■	N/A	N/A	N/A
Dell	Dimension, Precision	Desktop, laptop	Both	1 year	30 days	■	Included	Varies	BSC (TX)
	Performance	Desktop, laptop	Direct	1 year	30 days	■	Included	Varies	BSC (TX)
DFI	Desktop, medium tower, full-size tower DX/2-66	Desktop	Both	1 year	N/A	■	$49	N/A	AT&T (MD)
Diamond Technologies	DT	Desktop	Direct	15 months parts, 2 years labor	30 days	■	$75	10% per year	GE (GA)
Digital Equipment Corp.	DECpc	Desktop, laptop	Both	1 year	30 days	■	Included (desktop)	Varies	DEC (GA)
DTK	Grafika	Desktop	Dealers	1 year	N/A	■	Included	2d year, $222	GE (GA)
	Other desktops	Desktop	Dealers	1 year	N/A	■	N/A	N/A	N/A
	Laptop	Laptop	Dealers	1 year	N/A	■	N/A	N/A	N/A
Epson	Endeavor	Desktop	Direct	1 year	30 days	□	Included	N/A	Idea Servcom (AZ)
	Equity, Express Station, Progression	Desktop	Dealers	1 year	Varies	□	Included	N/A	Idea Servcom (AZ)
	ActionNote	Laptop	Dealers	1 year	Varies	□	Included	N/A	Idea Servcom (AZ)
Ergo	486 NoteBricks	Laptop	Direct	1 year	30 days	■	N/A	N/A	N/A
Expo Tech	All	Desktop, laptop	Direct	1 year	30 days	□	Included (desktop)	$99 per year	Dow Jones (NJ), Interlogic Trace (IL)
FutureTech	All	Laptop	Both	1 year	30 days	■	$89	$109 per year	CTS (CA)
Gateway 2000	Desktop	Desktop	Direct	1 year	30 days	■	Included	N/A	Dow Jones (NJ)
	Nomad	Laptop	Direct	1 year	30 days	■	N/A*	N/A	N/A
Hewlett-Packard	HP Vectra 386 and 486	Desktop	Dealers	2 years	N/A	■	Included	3 years, $210	Hewlett-Packard (CA)
IBM	PS/2	Desktop	Both	3 years	30 days	■	Included (3 years)	Varies	IBM (NY)
	PS/ValuePoint	Desktop	Both	1 year	30 days	■	Included	Varies	IBM (NY)
	PS/1	Desktop, laptop	Dealers	1 year	N/A	■	N/A*	4SX: 1 year, $89; 3 years, $179; 4DX: 1 year, $99; 3 years, $199	N/A
	ThinkPad	Laptop	Both	700, 720: 3 years; 300, 710T: 1 year	30 days	■	$40 (free through IBM Direct)	$40 per year	IBM (NY)
Image Microsystems	All	Desktop	Both	1 year	30 days	■	N/A	N/A	N/A
Insight	All	Desktop	Direct	1 year	30 days	■	N/A*	N/A	N/A
International Instrumentation Inc.	Blue Max	Desktop, laptop	Direct	1 year	30 days	□	Included	8% per year	International Instrumentation (CA)
Jetta	Jetbook	Laptop	Dealers	1 year	N/A	■	N/A	N/A	N/A
Keydata	386 and 486	Desktop, laptop	Both	18 months	30 days	■	Included (desktop)	9% per year	N/A
Leading Edge	WinPro, WinTower	Desktop	Dealers	2 years (or 1 year on-site)	N/A	□	Included (or 2 years off-site)	$199 per year	GE (GA), Datatech (Canada)
	N3, N4	Laptop	Dealers	1 year	N/A	■	N/A	N/A	N/A
Mega	Impact	Desktop	Both	1 year	30 days	■	N/A	N/A	N/A
	Intel Series	Desktop	Both	1 year	30 days	■	Varies	Varies	Computer Vision (MA)
Memorex Telex	8000 Series,	Desktop, laptop	Direct	1 year	N/A	■	Varies	Varies	Memorex Telex (TX)
Micro Express	Desktop	Desktop	Direct	2 years	30 days	■	$50	$50 per year	GE (GA)

N/A—Not applicable The company does not offer this service for the product * The company will send prompt replacements for defective portables This kind of warranty may have an additional cost

CONTINUES

Primary technical-support number	Technical-support hours (eastern time)	On-line bulletin board service	Remote diagnostics/ Fax-back	Repair service handled by manufacturer or third party	Shipping charges to plant paid by	Shipping charges from plant paid by	Overnight shipping cost	Dealer repairs authorized
800-382-8324	9.00 A.M.–10 P.M. , M–F 10 00–6 00 Sat	214-620-2255	☐☐	Third party	Customer	Manufacturer	N/A	☐
800-382-8324	As above	214-620-2255	☐☐	Third party	Customer	Manufacturer	Free	☐
800-899-4508	10:00—10:00 M–F, 12:00–9:00 P.M. Sat.	818-961-6098	☐☐	Manufacturer	Customer	Manufacturer	30 days free, then varies	☐
800-543-6098	8.00—6 00 M–F	303-786-9921	■■	Manufacturer	Customer	Manufacturer	Varies	■
800-321-8990	11:00—8:00 M–F	510-623-2822	☐■	Manufacturer	Customer	Manufacturer	Varies	☐
800-624-9896	8.00 A.M.–10 P.M. M–F, 9 00—5:00 Sat.	512-338-8538	☐■	Third party	Customer	Manufacturer	Free	☐
800-624-9896	24 hours, 7 days	512-338-8538	☐■	Third party	Customer	Manufacturer	Free	☐
916-568-1234	9:00–8:00 M–F	None	☐☐	Manufacturer	Customer	Manufacturer	Varies	☐
800-989-7253	11 30—8 00 M–F	None	☐■	Manufacturer	Customer (after first 90 days)	Manufacturer	Free	■
800-722-9332	8:30–8:00 M–F	None	☐☐	Manufacturer	Customer	Manufacturer	Varies	■
800-925-7318	10 00–8 00 M–F	818-810-4726	☐■	Manufacturer	Customer	Manufacturer	N/A	■
800-925-7318	As above	818-810-4726	☐■	Manufacturer	Customer	Manufacturer	N/A	■
800-925-7318	As above	818-810-4726	☐■	Manufacturer	Customer	Manufacturer	N/A	■
800-922-8911	9:00–9:00 M–F	310-782-4531	☐■	Third party	Manufacturer	Manufacturer	$30	■
800-922-8911	As above	310-782-4531	☐■	Third party	Manufacturer	Manufacturer	$30	■
800-922-8911	As above	310-782-4531	☐■	Third party	Manufacturer	Manufacturer	$30	■
800-633-1925	7:00–7.00 M–F	See warranty	■■	Manufacturer	Manufacturer	Manufacturer	$45	☐
800-288-3243	9:00–8:00 M–F, 11:00—4:00 Sat.–Sun.	708-540-0850	■■	Both	Customer	Manufacturer	Free	■
800-275-4414	8.00–8 00 M–F	None	☐☐	Manufacturer	Customer	Manufacturer	Free	■
800-846-2000	7:00 A.M.–1:00 A.M. M–F, 10:00-3:00 Sat.	605-232-2109	■■	Manufacturer	Customer	Manufacturer	Free	■
800-846-2000	As above	605-232-2109	■■	Manufacturer	Customer	Manufacturer	Free	■
800-333-1917	7.00 A.M.–8 00 P.M. M–F	408-720-3416	☐■	Manufacturer	Customer	Manufacturer	N/A	■
800-772-2227	24 hours, 7 days	404-835-6600	☐■	Manufacturer	N/A	N/A	N/A	■
800-426-2968	As above	404-835-6600	☐■	Manufacturer	N/A	N/A	N/A	■
800-765-4747	9:00—12:00 midnight M–F 12:00—9:00 P.M. Sat.–Sun.	Via Prodigy, America Online (preloaded)	☐☐	Manufacturer	Manufacturer	Manufacturer	Free	■
800-772-2227	24 hours, 7 days	404-835-6600	☐■	Manufacturer	Manufacturer	Manufacturer	Free	☐
800-578-9876	24 hours, 7 days	310-815-8121	☐☐	Manufacturer	Customer	Manufacturer	$36	■
See warranty	24 hours, 7 days	None	☐☐	Manufacturer	Customer	Manufacturer	$29	☐
800-543-3475	11.00—9 00 M–F	805-379-0601	■■	Manufacturer	Customer	Manufacturer	Varies	☐
908-329-9651	9:00—5:00 M–F	None	☐■	Manufacturer	Customer	Manufacturer	$75	■
800-486-9100	9:00—8.00 M–F, 10.00–4.00 Sat.	None	■■	Both	Customer	Manufacturer	$65, desktops; $35, laptops	■
800-245-9870	9:00—8:00 M–F	508-836-3967	☐■	Third party	Manufacturer	Manufacturer	N/A	■
800-245-9870	As above	508-836-3967	☐■	Third party	Manufacturer	Manufacturer	N/A	■
800-338-6628	11 00—8 00 M–F	None	☐☐	Manufacturer	Customer	Manufacturer	Varies	■
800-338-6628	As above	800-525-3019	☐■	Manufacturer	Customer	Manufacturer	Varies	☐
800-944-4455	9.00—6:00 M–F	None	■☐	Manufacturer	Customer	Manufacturer	Varies	☐
800-762-3378	24 hours, 7 days	None	☐■	Manufacturer	Customer (after first 4 months)	Manufacturer	Varies	☐

† Percentage of original system cost ** If the customer uses an overnight service to send a unit for repair, the company pays for overnight shipping to return it

PC Vendors: Technical Support and Service Policies

Companies listed in alphabetical order

■ = YES □ = NO

Company	Product lines	Type of machine	Dealers or direct-distribution channel	Standard warranty	Money-back warranty	Manufacturer's warranty worldwide	First-year on-site service charge	Subsequent on-site service charge	On-site service provider (and headquarters)
Micro Express	Laptop	Laptop	Direct	15 months	30 days	■	N/A	N/A	N/A
Micron	486VL, laptop	Desktop, laptop	Direct	1 year	30 days	■	Included	N/A	ISC/Bunker-Ramo (WA)
NCR	System 3000	Desktop, laptop	Both	3 years	N/A	□	Included	Varies	NCR (OH)
NEC	PowerMate	Desktop	Both	3 years	N/A	□	Included	2 years, $75	Local centers
	UltraLite Versa	Laptop	Both	3 years	N/A	□	Included	2 years, $99	Local centers
NETiS	All	Desktop	Both	1 year	30 days	■	$80	$200 per year	Nationwide (CA)
Northgate	Desktop	Desktop	Direct	1 year	30 days	□	Included	Varies	NCR (OH)
	Laptop	Laptop	Direct	1 year	30 days	□	N/A	N/A	N/A
Osicom	All	Desktop	Both	1 year	30 days	□	Varies	2d year, $249	Varies
PacTron	Pac-4XE, Pac-4XI	Desktop	Dealers	1 year	15 days	■	5%	N/A	Nationwide (CA)
Panasonic	Notebook	Laptop	Dealers	1 year	N/A	□	N/A	N/A	N/A
PC Brand	Leader Cache	Desktop	Direct	1 year	30 days	□	Included	$250 per year	Idea Servcom (AZ)
	LeaderBook Pro	Laptop	Direct	1 year	30 days	□	N/A	N/A	N/A
Polywell	Poly systems	Desktop	Both	1 year parts, 5 years labor	30 days	□	$75	2d year, $175	RTIN (CA)
Quill	Qtech	Desktop	Direct	1 year	30 days	□	Included	10% per year	Memorex Telex (TX)
Samsung	DeskMaster, NoteMaster	Desktop, laptop	Dealers	1 year	N/A	□	N/A	N/A	N/A
Sharp	PC-6700, PC-6800, PC-7700, PC-7750	Laptop	Dealers	1 year	N/A	□	N/A	N/A	N/A
Swan	Cygnet	Desktop	Direct	1 year	30 days	■	Included	2d year, $199	Idea Servcom (AZ)
	Direct Bus, EISA, V Line	Desktop	Direct	2 years	30 days	■	Included (2 years)	3d year, $229	Idea Servcom (AZ)
	Laptop	Laptop	Direct	1 year	30 days	■	N/A	N/A	N/A
Tandy	Omni-Profile	Desktop	Both	1 year	30 days	□	$129	$299 per year	Tandy (TX)
Tangent	Advanced desktops	Desktop	Direct	1 year	30 days	□	Included	10% per year	IAI (CA)
	Basic desktops	Desktop	Direct	1 year	30 days	□	$75	10% per year	IAI (CA)
Telemart	MITS systems	Desktop, laptop	Direct	2 years	30 days	■	Included (2 years)	N/A	Any local center
Tenex	All	Desktop, laptop	Direct	2 years	30 days	■	Included (desktop)	2d year, 10%	Idea Servcom (AZ)
Texas Instruments	TravelMate 4000	Laptop	Dealers	1 year	N/A	■	$120	$264 per year	TI (TX)
Toshiba	All	Laptop	Dealers	1 year	Varies	■	N/A	N/A	N/A
Tri-Star	Tri-CAD, Tri-Multimedia, Tri-Win	Desktop	Direct	2 years	30 days	■	Included	2d year, $250	Tri-Star (AZ)
Twinhead	Superset	Desktop	Both	1 year	N/A	□	Included	Varies	Dow Jones (NJ)
	Slimnote, SubNote	Laptop	Both	1 year	30 days	□	N/A*	N/A	N/A
Unisys	PW² Advantage, Advantage Plus	Desktop	Both	1 year	N/A	□	Varies	Varies	Unisys (PA)
United Micro	Galaxy	Desktop	Direct	1 year parts, 2 years labor	30 days	■	N/A	N/A	N/A
Unitek	486/33, /50, or /66 VLB, EISA VLB	Desktop	Direct	1 year parts, lifetime labor	30 days	□	Included	Varies	Nationwide (CA)
USA Flex	All	Desktop	Direct	1 year	30 days	■	Included	Varies	Dow Jones, NJ
Wyse	Wyse Decision	Desktop	Both	1 year	N/A	■	$49-$149	Varies	Hewlett-Packard (CA)
Zenith Data Systems	Z-Station, Z-400+	Desktop	Both	1 year	30 days (through Z-Direct)	■	Included	Varies	Group Bull HN (MA), ZDS (MI)
	625nL, Z-Lite, Z-Note, Z-Sport	Laptop	Both	1 year	30 days (through Z-Direct)	■	N/A**	N/A	ZDS (MI)
Zeos	Desktop, laptop	Desktop, laptop	Direct	1 year	30 days	■	$49 † (desktop)	$99 per year	Dow Jones (NJ)

N/A—Not applicable. The company does not offer this service for the product. * The company will send prompt replacements for defective portables. This kind of warranty may have an additional cost.

ENDS

Primary technical-support number	Technical-support hours (eastern time)	On-line bulletin board service	Remote diagnostics/ Fax-back	Repair service handled by manufacturer or third party	Shipping charges to plant paid by	Shipping charges from plant paid by	Overnight shipping cost	Dealer repairs authorized
800-762-3378	24 hours, 7 days	None	□■	Manufacturer	Customer (after first 4 months)	Manufacturer	Varies	□
800-438-3343	9:00 A.M.–10:00 P.M. M–F, 10:00–7:00 Sat.	None	□□	Manufacturer	Customer	Manufacturer	Varies	■
800-531-2222	24 hours, 7 days	800-832-0627	□■	Manufacturer	Customer	Manufacturer	Free	■
800-388-8888	8:30–8:00 M–F	508-635-4706	□■	Both	Customer	Manufacturer	Free	■
800-388-8888	24 hours, 7 days	508-635-4706	■■	Both	Manufacturer	Manufacturer	Free	■
408-263-0395 (collect)	11:00–9:00 M–F, 1:00–8:00 P.M. Sat.	None	■■	Manufacturer	Customer	Manufacturer	$20	■
800-448-5037	24 hours, 7 days	612-943-6993	□□	Manufacturer	Customer	Manufacturer	Free	□
800-448-5037	As above	612-943-6993	□□	Manufacturer	Customer	Manufacturer	Free	□
800-296-3456	9:00–5:30 M–F	None	□■	Both	Customer	Manufacturer	N/A	■
800-775-8766	11:30–8:30 M–F	None	□■	Manufacturer	Customer	Manufacturer	Varies	□
800-527-8675	9:00–8:00 M–F	None	□□	Manufacturer	Manufacturer	Manufacturer	Free	■
800-722-7263	7:30–7, M–F; 10–6, Sat	805-378-3000	□■	Manufacturer	Customer (after first 90 days)	Manufacturer	Varies	□
800-722-7263	As above	805-378-3000	□■	Manufacturer	Customer (after first 90 days)	Manufacturer	$29	□
800-999-1278	11:30–8:30 M–F, 4:00–8:00 P.M. Sat.	None	□□	Manufacturer	Customer	Manufacturer	$35	■
708-634-8650	8:30–8:30 M–F	None	□■	Manufacturer	Customer	Manufacturer	Free	■
800-446-0262	9:00–5:30 M–F	201-691-6238	□□	Both	Customer	Manufacturer	Varies	□
800-732-8221	9:00–8:00 M–F	None	□□	Manufacturer	Customer	Customer	N/A	■
800-468-7926	9:00–9:00 M–F, 9:00–5:00 Sat.-Sun.	814-237-6145	■□	Manufacturer	Customer	Manufacturer	Varies	□
800-468-7926	As above	814-237-6145	■□	Manufacturer	Customer	Manufacturer	Varies	□
800-468-7926	As above	814-237-6145	■□	Manufacturer	Customer	Manufacturer	Varies	□
817-390-3861	9:30–6:30 M–F	None	■■	Manufacturer	N/A	N/A	N/A	□
800-800-6060	11:00–8:00 M–F, 12:00–5:00 P.M. Sat.	415-342-7047	□□	Manufacturer	Customer	Manufacturer	Free**	□
800-800-6060	As above	415-342-7047	□□	Manufacturer	Customer	Manufacturer	Free**	□
800-336-4309	10:00–7:00 M–F	602-943-1472	□■	Both	Customer	Manufacturer	Free	■
800-326-7957	7:00–7:00 M–F	219-256-9325	□■	Both	Customer	Manufacturer	$49.99	□
800-848-3927	8:00–8:00 M–F	None	□□	Manufacturer	Customer	Manufacturer	Free	□
800-999-4273	10:00–8:00 M–F	714-837-4408	□□	Both	Customer	Manufacturer	Free	■
800-800-7668	10:00–9:00 M–F	602-961-1406	□■	Both	Customer	Manufacturer	Free	□
800-767-8946	9:00–9:00 M–F, 12:00–7:00 P.M. Sat.	408-945-8334	□□	Both	Manufacturer	Manufacturer	Free	□
800-767-8946	As above	408-945-8334	□□	Manufacturer	Customer (after first 30 days)	Manufacturer	$25–$35	□
800-328-0440	8:00–8:00 M–F	800-828-8798	□■	Manufacturer	Customer	Manufacturer	Varies	■
800-886-4833	10:00–6:00 M–F	None	□■	Manufacturer	Customer (after first 30 days)	Manufacturer	Varies	■
800-944-8700	11:00–11:00 M–F; 1:00–6:00 P.M. Sat., holidays	909-930-5711	□■	Both	Manufacturer	Manufacturer	Varies	□
800-955-1488	24 hrs, 7 days	708-351-6048	□■	Manufacturer	Customer	Manufacturer	Free	□
800-800-9973	11:00–7:00 M–F	408-922-4400	□■	Both	Customer	Manufacturer	N/A	□
800-227-3360	8:00 A.M.–12:00 midnight M–F	708-808-2264	■□	Both	Customer	Manufacturer	Free	■
800-227-3360	As above	708-808-2264	■□	Both	Customer	Manufacturer	Free	■
800-228-5390	24 hours, 7 days	612-633-0815	□■	Manufacturer	Customer	Manufacturer	Free**	□

† Percentage of original system cost ** If the customer uses an overnight service to send a unit for repair, the company pays for overnight shipping to return it

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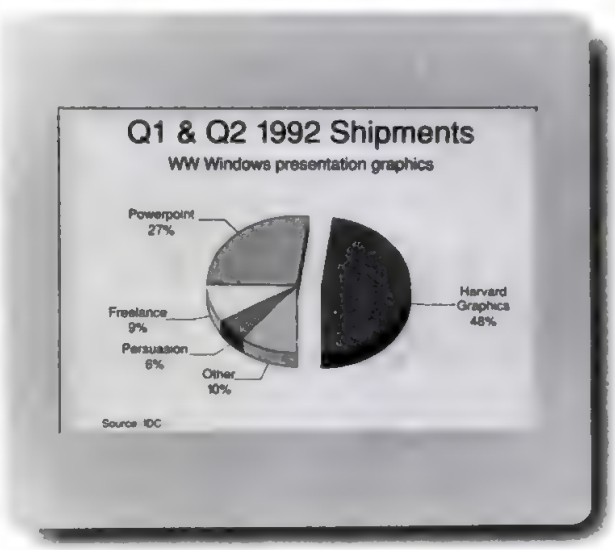

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SUPPORT & SATISFACTION

How Happy Are You... Really?

We asked you to tell us how satisfied you are with the software you use every day and with vendor support. Here's a close look at what you like and why you like it.

by Peggy Watt

Software has come a long way over the years. It's more feature-rich and more usable than ever before. But even though a kinder, gentler user interface masks some of the complexity of its features, software is actually more complicated than ever before. Keeping the customers satisfied requires a blend of features, usability, and aggressive customer support. And satisfaction translates to a loyal customer.

As *PC Magazine* turns again to its annual survey of software satisfaction and support, where we survey 17,000 *PC Magazine* readers (see the sidebar "How We Surveyed," earlier in this issue), we find a well-seasoned crowd of veterans. There are many upgrades in the batch but very few newcomers. Notable exceptions are Microsoft's entry into the database market—Microsoft Access—and Borland International's Windows implementations of its Paradox and Quattro Pro packages.

Are customers satis-

fied? You bet. On a scale of 1 to 10, users generally gave satisfaction ratings of 8 or above to software in various categories. The lowest aggregate scores for satisfaction were still a healthy 7.9 (in the database and graphics categories).

Trends are quite tough to pinpoint. Although Windows products frequently earned higher votes of confidence than DOS products did, there were some notable and significant exceptions. DOS products Quattro Pro and WordPerfect for DOS both earned high scores for overall satisfaction. And databases remain a DOS stronghold. Alpha Four, CA-Clipper, Microsoft FoxPro, and Paradox for DOS, all DOS products, topped the scores for overall user satisfaction.

As vendors continue to match one another on checklists of features, the battle for users' hearts and minds extends to other fields. Technical support is one of them.

WordPerfect's technical support policy scored well across many categories of technical support. The company offers unlimited toll-free support—no toll calls, no service charge—and its lines are open for extended hours for callers across the country (but, interestingly, only on weekdays). Besides an active CompuServe forum, WordPerfect provides its own BBS (a toll call) to enable customers to reach technical support staff and offers extended and corporate support plans. But toll-free technical support is costly, and we'll be keeping tabs on whether WordPerfect maintains its high standard.

WordPerfect for Windows and WordPerfect for DOS are an inseparable pair topping the ratings in the word processing support category. Less popular WordPerfect companion products PlanPerfect and DrawPerfect did not have the presence in our survey they had last year. Other products that did stand out this year on the technical support front were Ami Pro, Quattro Pro, and CorelDRAW.

Types of Technical Support: User Rankings

What kinds of technical support do you value? These were the most frequent answers among users of all categories of software.

1	Documentation
2	Replacement of defective disks
3	Built-in help
4	800-number support
5	Tutorials
6	Free support via toll number
7	CompuServe
8	Vendor BBS
9	Paid (premium) service

Users in our survey apparently prefer to have their help at their desks. They rated documentation most highly as a means of support, followed by replacement of defective disks and built-in help. Bulletin boards are not a high-priority item for most users. Some of the more esoteric forms of support, such as fax-back solutions, are still not mainstream solutions.

This was clearly the year of the graphical user interface (GUI). Predictably, Windows-based programs dominated the graphics division; they also took over in the spreadsheet arena. This year Windows finally broke into the database market, and it entered with a roar.

Windows operating systems and DOS, while they scored respectably in the majority of satisfaction ratings, did not take first place in the category. DR DOS and OS/2, though not hugely represented in terms of the number of respondents, got high ratings for overall satisfaction. Some of this was attributable to fewer but purposeful users who tend to be strongly motivated to move to these operating systems.

New releases and major updates did well—and many of them were Windows products. Quattro Pro for both DOS and Windows dominated the spreadsheet contest both in overall satisfaction and in satisfaction with technical support. Lotus Development Corp. had the greatest number of respondents, but users more than likely responded about many different versions of the long-lived 1-2-3. User dissatisfaction with older and occasionally ill-conceived versions may have affected overall satisfaction scores.

DR DOS and OS/2, though not hugely represented in terms of numbers, got high ratings for overall satisfaction.

Some interesting paradoxes emerged from the survey. Respondents voiced marginal interest in on-line support; but virtually every vendor has a CompuServe forum. Such outlets offer the opportunity for technical support and tips from fellow users as well as vendors.

WordPerfect is not alone in offering toll-free support, though clearly in the minority. Neither Borland nor Microsoft offer a toll-free support line (Borland does offer it as an optional service). Some vendors provide toll-free support for only 90 days after the first call. There's some logic to this: The longer you use the program, the less frequently you should need to call. At the other extreme, fewer vendors are experimenting with 900-number support (under which you pay a premium via your phone bill).

Paid (premium) support was not of great interest to the majority of users we polled. And when it came to written documentation, we found that, while two-thirds of respondents considered it important, ratings fell consistently below satisfactory levels. We also asked about vendor policies for replacing defective disks; most felt this was important.

You can still be satisfied with a product, even if you're not satisfied with the technical support its vendor offers. Microsoft Excel for Windows and Microsoft Word for Windows got high marks for overall satisfaction, even though their ratings for satisfaction with technical support were somewhat lackluster. CA-Clipper, near the top of the database heap for overall satisfaction, was rated significantly below average for satisfaction with technical support.

Customer satisfaction is the sum of many things. In an era when the norm consists of more upgrades to existing packages than new product entries, it's important that you get to voice your satisfaction or displeasure with your tools and how they evolve over time. We will continue to provide you with this forum to air your views.

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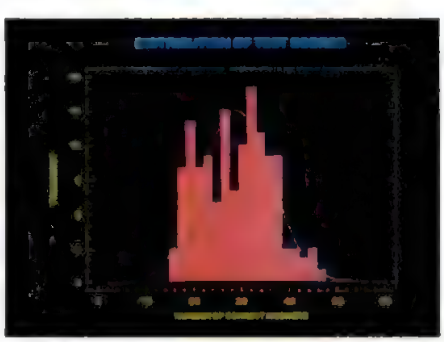

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CIRCLE 081 ON READER SERVICE CARD

HIGHLIGHTS

Operating Systems and Environments

Times change. This is the first time we've had enough different choices to warrant a poll on user satisfaction and support in the operating systems category. Bear in mind that the way in which you come by your operating system is different from most of the other software you'll ever run on your PC. Windows and/or DOS are preinstalled on many new machines; hence, the decision to use them is a passive one. On the other hand, choosing OS/2, DR DOS, and others tends to be more of an active decision. Active decisions, decisions of choice, tend to be rated more satisfactorily.

Five products were included in this category. DOS and Microsoft Windows were hugely dominant. More than 3,800 DOS users and 3,700 Windows users responded to our survey, compared with 241 OS/2 users and 192 users of Novell's DR DOS. Quarterdeck Office Systems' DESQview, which runs on top of DOS, trailed the pack in raw numbers. It netted just 88 responses.

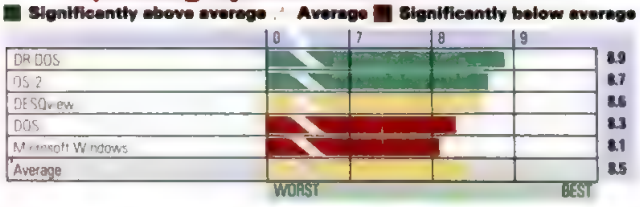
Still, the smaller numbers were certainly devoted numbers. DR DOS was the clear winner, the only package that scored above average both in overall satisfaction and in technical support. Digital Research, which was recently acquired by Novell, has long touted its alternative to DOS as a better product, but it has made little headway in the usual markets. DR DOS's dominance has been on ROM chips in laptop systems. Perhaps the underdogs bark loudest! Besides DR DOS's good showing from its users, OS/2 users rallied to voice great satisfaction. Windows was the loser—but only by comparison; satisfaction levels were high for all products. The two entries that fell below the mean average—Windows and DOS—support by far the most users.

Product support was DR DOS's show—it lacks market share, but satisfied users applauded. DR DOS was the highest-rated in overall technical support, followed by OS/2. It is conspicuous that Microsoft, the vendor of almost half the entries in this category, does not provide a toll-free line. Only Quarterdeck and Novell offer 800-number support. Novell provides its support for 30 days; Quarterdeck's support is unlimited.

DOS—everybody's favorite whipping boy—got slammed for its lack of built-in help. CompuServe and other on-line support did not appear to be a priority for operating environments.

Windows has weathered a stormy journey to respectability. Certainly, if we'd done this same kind of survey on Windows 3.0 users, we would probably have seen even lower scores. Windows 3.1 has come a long way, with a lot further to go. With the recent, somewhat troubled release of MS-DOS 6, the anticipated entry of NT, pending updates to OS/2, and a host of new Unix-based players on the Intel platform, this category is one to watch.

How Readers Rated the Software:
Operating Systems and Environments



DOS and Windows users far outnumbered the OS/2 and DR DOS users in our survey. But those who use OS/2 and DR DOS expressed overwhelming satisfaction with the products.

HIGHLIGHTS

Word Processors

By and large, word processor users are a satisfied lot. They gave their products respectable scores in both overall satisfaction and satisfaction with technical support. Many are making the transition to Windows, but DOS remains a stronghold. Ami Pro for Windows, Word for Windows, and WordPerfect for DOS all ranked above average in our overall satisfaction category. Ami had a smaller number of respondents than either of the runners-up, but clearly these users were content.

The old familiars, Software Publishing Co.'s Professional Write and WordStar, from WordStar International, had a high number of respondents. Neither group of users expressed strong satisfaction with their choices, but this is where old habits weigh heavily. Many of these are probably longtime users, adverse to switching.

This year's survey was also a time for goodbyes. Entries in past years, Software Publishing Corp.'s Professional Write for Windows, IBM's DisplayWrite, and WordStar for Windows all dropped into oblivion in our ratings.

How Readers Rated Technical Support:
Operating Systems and Environments

■ Significantly above average
Average
■ Significantly below average

	Satisfaction with support	800-number support	Free support via toll number	Paid (premium) service	Documentation	CompuServe	Vendor BBS	Built-in help	Tutorials	Replacement of defective disks
DR DOS	89■	87■	85■	55	83■	78	78	82■	76	93
OS/2	82	82■	79	68	60■	81	83■	80■	76■	85
Microsoft Windows	77■	71■	71	69	74■	79	73	72	70	88
DESQview	74	69	69	81	70	76	76	60■	55	88
DOS	73■	69■	62■	59	72	69■	66■	60■	61■	80■
Average	79	76	73	66	72	77	75	71	68	87

Users of DR DOS and OS/2 expressed high satisfaction with the various categories of technical support.

In each chart, whether the scores fall outside the *average* range depends on statistically significant differences, as described in the sidebar "How We Surveyed."

How Readers Rated Technical Support: Word Processors

■ Significantly above average
Average
■ Significantly below average

	Satisfaction with support	800-number support	Free support via toll number	Paid (premium) service	Documentation	CompuServe	Vendor BBS	Built-in help	Tutorials	Replacement of defective disks
WordPerfect for Windows	91■	92■	85■	69	80	84■	81■	78■	79■	96■
WordPerfect for DOS	90■	91■	85■	75■	79	81	80■	76	76	93■
Ami Pro for Windows	88■	79	81■	64	80■	84■	80	80■	78	90
Microsoft Word for Windows	82	72■	75	71	78	79	77	78■	77■	93■
Microsoft Word for DOS	80	74	72	64	77	81	61	70■	74	80
Professional Write for DOS	79■	69	66	59	78	60	66	77	75	79
WordStar for DOS	77■	73	66■	73	77	73	64	71■	70■	83
Average	84	78	76	68	78	77	73	76	75	88

Just as in the overall satisfaction ratings, WordPerfect for Windows and DOS and Ami Pro for Windows topped users' satisfaction with technical support.

In this category we find the crown prince of support: WordPerfect Corp.

Anecdotally, U.S. West had to install a new call-switching station to accommodate the volume of WordPerfect's calls when the company built a new facility a few years ago. Users are enthusiastic about the company's toll-free number. Nearly half of the respondents in the survey rated toll-free support "highly important."

But Ami Pro, from Lotus Development Corp., is well poised to inherit the throne. Toll-free support and product maturity propelled Ami Pro past the other Windows word processors.

WordPerfect led the pack when we delved into the satisfaction with various kinds of support as well. Perhaps the company's reputation for phone support spills over. Both versions of WordPerfect got top marks for on-line support, even though word processor users as a whole did not consider CompuServe or private BBS support a high priority. Ami Pro consistently nudged against the WordPerfect leaders, earning kudos for documentation in particular. Documentation was considered "highly important" by two-thirds of the respondents. It seems that users value a good reference manual, even though the GUI crusaders claim that great on-line help, an intuitive and common user interface, and consistent operating commands across applications render paper documentation unimportant.

One feature of word processing packages that could universally stand significant improvement is the tutorial. About one-third of all survey respondents considered tutorials important, and, considering their proliferation, they are apparently a vendor priority these days. But vendors, take heed: Tutorials got some of the lowest ratings when our survey respondents were asked to prioritize. With new versions of all major word processors due out by the fall, and with their emphasis on usability, you might find that next year's scores turn out to be wildly different. Another interesting phenomenon to pay attention to is the way that some vendors are now beginning to outsource their phone support to third-party companies.

How Readers Rated the Software: Word Processors

■ Significantly above average Average ■ Significantly below average

Windows word processors got a strong vote of confidence in our survey, but DOS apps are not about to disappear. WordPerfect for DOS remains popular among our readers.

H I G H L I G H T S

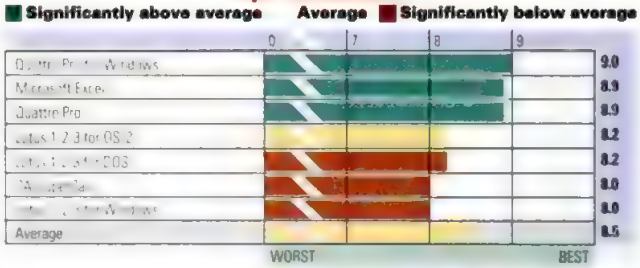
Spreadsheets

Lotus Development Corp. once reigned in spreadsheets, but that picture continues to change, and fast. This year the number of users of Microsoft Excel for Windows who responded approached the number of Lotus 1-2-3 for DOS and Windows users combined. And Quattro Pro clearly walks away with some satisfied and well-supported users. With three entries in this category—1-2-3 for OS/2, 1-2-3 for DOS, and 1-2-3 for Windows—Lotus still lost the crown for overall satisfaction to both the DOS and Windows versions of Borland International's Quattro Pro and also to Microsoft's Excel. But none of the products fared poorly. Across the board, users gave high marks to their spreadsheets.

In overall satisfaction, Quattro Pro for Windows and DOS, as well as Excel, led the category. In addition, both of Borland's products led user ratings in satisfaction with overall technical support.

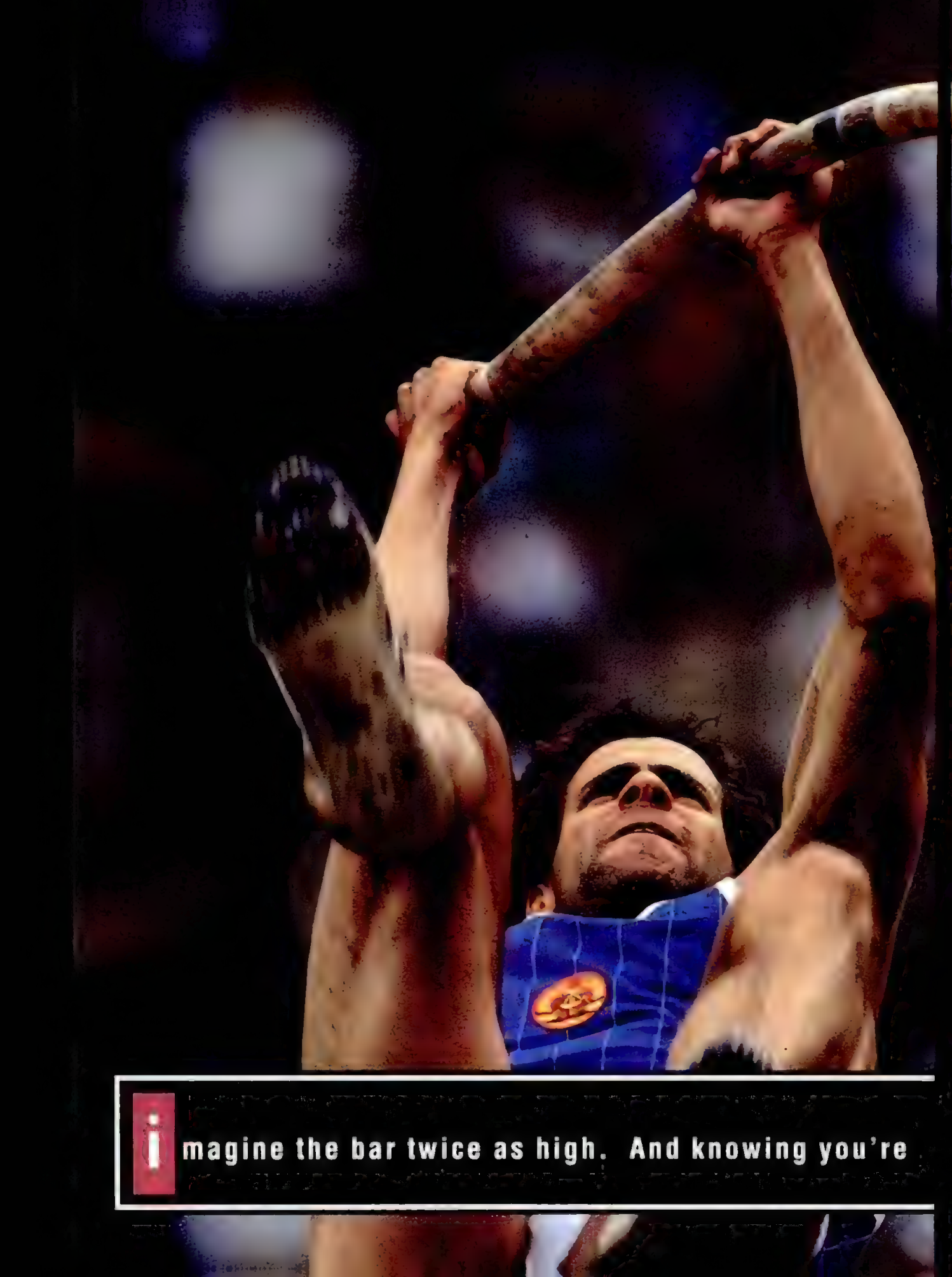
How Readers Rated the Software: Spreadsheets

■ Significantly above average Average ■ Significantly below average



Windows spreadsheets are challenging DOS favorites, but Borland International's Quattro Pro for DOS scores high for reader satisfaction. Readers gave all the products in this category good marks.

imagine



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Folded edge of the page

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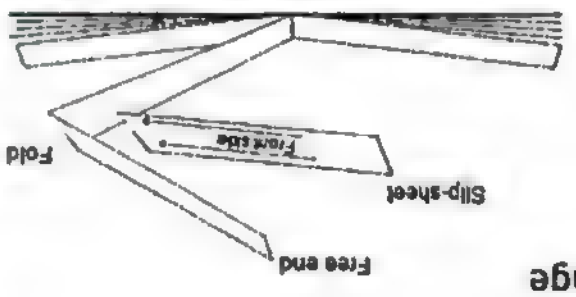
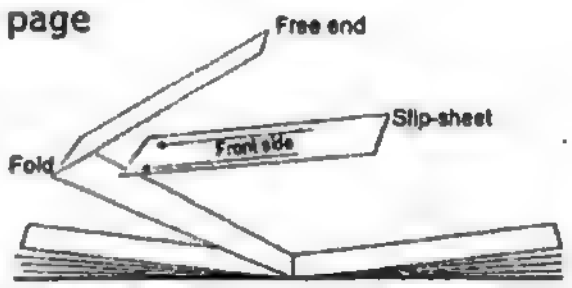
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



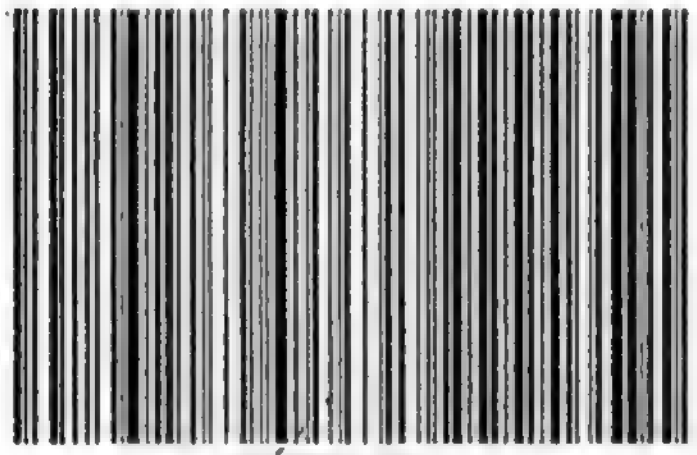
Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Back

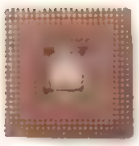
1. Follow instructions on the other side



Back

1. Follow instructions on the other side

A vaulting pole made of fiberglass and graphite instead of wood. An engine powered by fuel injection, not a carburetor. A radical improvement in the tools you use can radically improve your own performance.



The information you can address on an average 486 chip could fill 111 file cabinets

The information you can address on a not-so-average AXP chip could fill enough file cabinets to circle Earth 5 000 times

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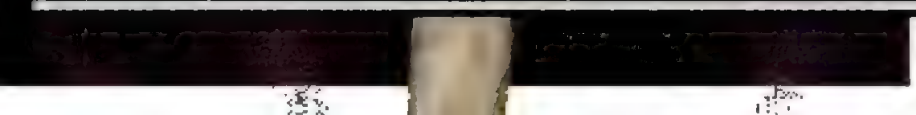

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Windows NT

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Advanced networking

Built-in security

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Runs MS-DOS and Windows (16 and future 32-bit) applications

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Costa Rica 50 6 337-133
Denmark 45 45 76-96-66
Dominican Republic 809 688-4491
Ecuador 59 3 256-4963
Fiji 679 315045
Finland 358 0 434-41
France 33 1 69-87-51-11
Germany 49 89 95-91-0
Greece 30 1-6854-400
Guatemala 50 2 232-2365
Holland 31 30 83-91-11
Hong Kong 852 805-3174
Hungary 361 1668 011
India 91 812 344077
Indonesia 62 021 3909429
Ireland 353 1 38-54-33
Israel 972 52 59-31-11
Italy 39 2 66-181
Japan 81 3 3989-7230
Korea 82 2 7991114
Luxemburg 352 39-92-61
Malesia 603 245-8678
Mexico 91 800-0210
New Zealand 64 9 3075555
Norway 47 2 16-02-90
Pakistan 92 21 51-3551
Panama 50 7 60-6500
Peru 51 14 453-554
Philippines 632 810-5156
Portugal 351 1 387-70-51
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■ Significantly above average
Average
■ Significantly below average

How Readers Rated Technical Support: Spreadsheets

	Satisfaction with support	800-number support	Free support via toll number	Paid (premium) service	Documentation	CompuServe	Vendor BBS	Built-in help	Tutorials	Replacement of defective disks
Quattro Pro for Windows	81■	75	77	54	84■	81	78	81■	75	91
Quattro Pro	83■	77	73	66	87■	77	73	75	73	83
Microsoft Excel	82	81■	75	69	78	78	75	78■	78■	91■
Lotus 1-2-3 for Windows	81	79	74	67	74■	78	75	75	73	85
Lotus 1-2-3 for OS/2	80	83	67	74	75	85■	90■	76	75	76
CA-SuperCalc	77	76	72	71	80	58	60	67■	62■	84
Lotus 1-2-3 for DOS	75■	73	68	65	74■	67■	61■	68■	69■	82
Average	80	78	74	67	78	75	73	74	72	85

Borland International's Quattro Pro spreadsheets for Windows and DOS earned high ratings in user satisfaction with technical support. Entries from Lotus Development Corp. got average and below-average marks.

The ratings make Borland the WordPerfect of spreadsheets.

Lotus may have shipped too little, too late with its Windows version of 1-2-3. In fact, that product and the DOS version fall below the OS/2 version for overall ratings. The OS/2 version's good showing may be misleading; that user population is magnitudes smaller than other products in our survey, and the product has virtually no competition in the OS/2 environment. The also-ran in this category is old-timer CA-SuperCalc from Computer Associates International, which has been around longer than even Lotus and still has its share of fans. Its ratings were quite good (8.0 in overall satisfaction and 7.7 in satisfaction with overall technical support), but even this high score fell significantly below the average when compared with others on the overall satisfaction side.

Graphical user interfaces (GUIs) dominate the category. In the support arena, users' priorities reflect a reliance on good documentation followed by graphical values, such as built-in help systems. 1-2-3 for DOS and CA-SuperCalc users expressed low satisfaction with built-in help; Lotus may be doing a better job with its newer, GUI-er products. Excel got a high rating for its tutorials, which were rated as very important by 28 percent of the users. A like percentage of Quattro Pro for DOS users (25 percent) said tutorials were very important, but they were less satisfied.

Spreadsheet vendors typically offer paid (premium) support plans for corporate customers. As with other categories, our survey found this to be a low priority item. Only 6 percent rated on-line support an important feature. About two-thirds of the users wanted strong written documentation, and about half said they wanted built-in help systems. Toll-free support is important to these users, but only Lotus provides it.

A three-way tie for lead place ensues among the Alpha Four, FoxPro, and Clipper database programs.

Again, with a whole new round of products from Lotus, Microsoft, and Borland that bear the fruits of intensive usability testing, and with innovative products such as Lotus Improv and CA-Compete 5.0 adding "new dimensions" to spreadsheets, next year's snapshot could turn out to be very different indeed.

HIGHLIGHTS

Databases

Database management systems win as this year's liveliest category. The list of products include updated versions of just about all products and some entirely new entries. Both Microsoft Access and Borland International's Paradox for Windows emerged on the scene with great fanfare. The database category also produced some of the lowest scores for both overall satisfaction and satisfaction with technical support; this crowd of users is a demanding one.

Not only were the ratings for databases generally lower than for other software categories, but the spread between the highest and lowest ratings was small. A three-way tie for lead place ensues among Alpha Four, FoxPro, and Clipper. And other than Alpha Four, which hasn't changed significantly since last year, the product scene was relatively tumultuous. Computer Associates International purchased Clipper from Nantucket Corp. but had not shipped its new Version 5.2 at the time of the survey. FoxPro, originally from Fox Software, is now owned by Microsoft. There were newcomers Access and Paradox for Windows, as well as Paradox for DOS, which was also upgraded this year. Consistently trailing in the ratings were Microrim's R:BASE, DataEase International's DataEase, and dBASE, although all were recently updated.

Paralleling the spreadsheet category, Borland's Paradox for Windows was the users' clear-cut winner for satisfaction with overall technical support and led many individual technical support categories. Q&A, from Symantec Corp., also runs strong in overall technical support, although it did not fare as well in overall satisfaction.

Another Borland entry, dBASE (acquired from Ashton-Tate Corp. two years ago but updated by Borland since), hovered in the midrange ratings along with Oracle. Borland recently released dBASE IV, Version 2.0, and finally made

Software Vendors: Support Offerings

by Anush Yegyazarian

In an era where upgrades are increasingly common and expected, and where most products in any given category share popular features, support is becoming a key differentiator. *PC Magazine* again brings you a summary of the current support policies for the key software packages readers were asked about in the current survey. Keep in mind that the following table is a summary and covers the basic policies of vendors. In cases where vendors have

Company	Product	800 number	Period of access to 800 number	900 number	Local-area number	Technical support hours (eastern)
Adobe Systems Inc.	Adobe Illustrator	None	N/A	None	408-986-6530	9:00–8:00 M–Th, 9:00–5:00 F
Aldus Corp.	Aldus FreeHand	Optional*	Varies	900-226-2261	206-628-4532	10:00–8:00 M–F
	Aldus PageMaker	Optional*	Varies	900-226-2261	206-628-4531	10:00–8:00 M–F
	Aldus Persuasion	Optional*	Varies	900-226-2261	206-628-4533	10:00–8:00 M–F
Alpha Software Corp.	Alpha Four	None	N/A	None	617-272-3680	9:15–7:00 M–F
Approach Software Corp.	Approach for Windows	None	N/A	None	415-306-0646	9:30–8:00 M–Th, 9:30–7:00 F
Borland International Inc.	dBASE	Optional*	Varies	900-555-1003	408-431-9060	9:00–8:00 M–F
	Paradox for DOS	Optional*	Varies	900-555-1000	408-461-9155	9:00–8:00 M–F
	Paradox for Windows	Optional*	Varies	900-555-1000	408-461-9166	9:00–8:00 M–F
	Quattro Pro for DOS	Optional*	Varies	900-551-1001	408-461-9122	9:00–8:00 M–F
	Quattro Pro for Windows	Optional*	Varies	900-555-1001	408-461-9122	9:00–8:00 M–F
Computer Associates	CA-Clipper	Optional*	Varies	None	310-348-4400	9:00–8:00 M–F
International Inc.	CA-SuperCalc	Optional*	Varies	None	408-432-1764	9:00–8:00 M–F
Corel Corp.	CorelDRAW	None	N/A	None	613-728-1990	4:00 A.M.–8:00 P.M. M–F
DataEase International Inc.	DataEase	Optional*	Varies	900-446-3273	203-374-2825	9:00–8:00 M–Th, 9:00–6:00 F
DeScribe Inc.	DeScribe (for OS/2, Windows)	None	N/A	None	916-646-1111	11:00–8:00 M–F
IBM Corp.	OS/2	800-237-5511	Unlimited	None	None	8:00–8:00 M–F, 9:00–6:00 Sat.–Sun.
Lotus Development Corp.	Ami Pro (for OS/2, Windows)	None	N/A	None	404-399-5505	24 hours M–Sat.
	Freelance Graphics (for DOS, OS/2, Windows)	800-223-1662	90 days	900-454-9009	None	8:30–8:00 M–F
	Lotus 1-2-3 (for DOS, OS/2, Windows)	800-223-1662	90 days	900-454-9009	None	24 hours, 7 days
Micro Data Base Systems Inc. (mdbs)	KnowledgeMan	None	N/A	None	317-448-6187	8:00–5:00 M–F
Micrografx Inc.	Designer	None	N/A	None	214-234-2694	24 hours M–F, 9:00–6:00 Sat.–Sun.
	Windows Draw	None	N/A	None	214-234-2694	24 hours M–F, 9:00–6:00 Sat.–Sun.
Microrim Inc.	R:BASE	Optional*	Varies	900-454-9730	206-649-9551	10:00–7:00 M–F
Microsoft Corp.	Microsoft Access	None	N/A	None	206-635-7050	9:00–9:00 M–F
	Microsoft Excel	None	N/A	None	206-635-7070	9:00–9:00 M–F
	Microsoft FoxPro	None	N/A	None	206-635-7191	9:00–9:00 M–F
	Microsoft PowerPoint	None	N/A	None	206-635-7145	9:00–9:00 M–F
	Microsoft Windows	None	N/A	None	206-637-7098	9:00–9:00 M–F
	Microsoft Word for DOS	None	N/A	None	206-635-7210	9:00–9:00 M–F
	Microsoft Word for Windows	None	N/A	None	206-462-9673	9:00–9:00 M–F
	MS-DOS	None	N/A	900-555-2000	206-646-5104	9:00–9:00 M–F
	Multiplan	None	N/A	None	206-454-2030	9:00–9:00 M–F
Novell Inc.	DR DOS	800-638-9273	30 days	900-443-4374	None	8:00–8:00 M–F
Oracle Corp.	Oracle	Optional*	Varies	None	415-506-1500	8:00 A.M.–9:00 P.M. M–F
Quark Inc.	QuarkXPress	None	N/A	None	303-894-8822	9:00–7:00 M–F
Quarterdeck Office Systems	DESQview	800-762-6832	Unlimited	None	310-392-9701	5:30 A.M.–7:30 P.M. M–F
Software Publishing Corp.	Harvard Graphics for DOS	Optional*	Varies	None	408-988-4005	10:00–7:00 M–F
	Harvard Graphics for Windows	Optional*	Varies	None	408-988-4005	10:00–7:00 M–F
	Professional Write for DOS	Optional*	Varies	None	608-274-9715	9:00–7:00 M–F
	Professional Write for Windows	Optional*	Varies	None	608-274-4391	10:00–4:00 M–F
Symantec Corp.	Q&A	None	N/A	None	408-252-5700	9:00–8:00 M–F
Ventura Software Inc.	Ventura Publisher	800-822-8221	90 days	900-896-8880	619-673-0172	10:00–7:00 M–F
WordPerfect Corp.	WordPerfect for DOS	800-541-5096	Unlimited	None	801-226-7900	9:00–8:00 M–F
	WordPerfect for OS/2	800-321-1230	Unlimited	None	801-225-4900	9:00–8:00 M–F
	WordPerfect for Windows	800-228-1029	Unlimited	None	801-228-9907	9:00–8:00 M–F
WordStar International Inc.	WordStar (for DOS, Windows)	None	N/A	900-555-7827**	404-428-0008	9:00–6:00 M–F

N/A—Not applicable: The vendor does not offer this service for the product.
V—A voice number for an automated fax-back service.

* Available for an extra cost.
** For products no longer under warranty.

told us that they provide a listed service at additional cost, we have indicated this. But since not all vendors provided us with additional information, do not assume, for example, that a vendor with "none" in the 800-number column does not offer that service as part of an extended or corporate plan. Prices for such plans vary widely (contact vendors for details). Unless specifically indicated, all listed fax service numbers are fax receiving numbers, not automated phone services that will fax back documentation.

Public BBS	Service forums or commands	Private BBS number	Extended support	Corporate support	Fax service number
CompuServe	Adobe Forum	N/A	No	No	408-562-6767
CompuServe	GO Aldusfor	N/A	Yes	Yes	206-628-5737 (V)
CompuServe	GO Aldusfor	N/A	Yes	Yes	206-628-5737 (V)
CompuServe	GO Aldusfor	N/A	Yes	Yes	206-628-5737 (V)
CompuServe; Prodigy	P.C. Vendor's Support Forum–Section 15; Alpha Forum in Computer Club	617-229-2915	Yes	Yes	617-273-1507
CompuServe; Internet	76646,3367; help@approach.com	415-368-5390	No	Yes	415-368-5273
CompuServe; BIX; GEnie	GO BORLAND; JOIN BORLAND; BORLAND	408-439-9096	No	Yes	800-822-4269
CompuServe; BIX; GEnie	GO BORLAND; JOIN BORLAND; BORLAND	408-439-9096	No	Yes	800-822-4269
CompuServe; BIX; GEnie	GO BORLAND; JOIN BORLAND; BORLAND	408-439-9096	No	Yes	800-822-4269
CompuServe; BIX; GEnie	GO BORLAND; JOIN BORLAND; BORLAND	408-439-9096	No	Yes	800-822-4269
CompuServe; BIX; GEnie	GO BORLAND; JOIN BORLAND; BORLAND	408-439-9096	No	Yes	800-822-4269
CompuServe	GO Clipper	N/A	Yes	Yes	310-348-4401
CompuServe	Caipro	N/A	Yes	Yes	408-954-8947
CompuServe	GO Corel	613-728-4752	Yes	No	613-761-9175
CompuServe	GO DataEase	203-374-6302	Yes	Yes	203-374-2020
CompuServe; Prodigy	GO Describe; Computer BB: Describe, OS2, Word Processor	916-929-3237	Yes	Yes	916-923-3447
CompuServe	OS2USER, OS2SUPPORT, OS2DF1, OS2DF2	404-835-6600	Yes	Yes	800-426-4329 (V)
CompuServe	LotusWP Forum	404-395-7707	No	Yes	800-421-6264 (V)
CompuServe	LotusB Forum	617-693-7000 (2,400-bps); 617-693-7001 (9,600-bps)	Yes	Yes	617-253-9150 (V)
CompuServe	LotusA Forum	617-693-7000 (2,400-bps); 617-693-7001 (9,600-bps)	Yes	Yes	617-253-9150 (V)
None	N/A	317-447-6685	Yes	Yes	317-448-6428
CompuServe; America On-line	Winnapp Forum A, Section 10	214-644-4194	Yes	Yes	214-994-6476
CompuServe; America On-line	Winnapp Forum A, Section 10	214-644-4194	Yes	Yes	214-994-6476
None	N/A	206-649-9836	Yes	Yes	206-649-2789 (V)
CompuServe	MSAccess	206-936-6735 (download only)	No	Yes	206-635-7051 (V)
CompuServe	MSExcel	206-936-6735 (download only)	No	Yes	206-635-7071 (V)
CompuServe	Foxforum	206-936-6735 (download only)	No	Yes	206-635-7190 (V)
CompuServe	MSAPP	206-936-6735 (download only)	No	Yes	None
CompuServe	WINNEW, WINADV, WINNT	206-936-6735 (download only)	No	Yes	206-635-7245 (V)
CompuServe	MSWord	206-936-6735 (download only)	No	Yes	206-635-7211 (V)
CompuServe	MSWord	206-936-6735 (download only)	No	Yes	206-635-7231 (V)
CompuServe	MSDOS	206-936-6735 (download only)	No	Yes	206-646-5103 (V)
CompuServe	MSAPP	206-936-6735 (download only)	No	Yes	None
CompuServe	GO NDSG	408-649-3443 (2,400-bps); 408-649-3696 (9,600-bps)	No	No	408-649-8209
CompuServe	Oracle Forum	Available to customers only	Yes	Yes	Available to customers only
CompuServe; America On-line	Desktop Publishing Forum	None	Yes	Yes	None
CompuServe; BIX; Internet; Fidonet; Smartnet	GO Quarterdeck; join desqview; support@qdeck.com, desqviewecho; QEMM/Desqview	310-314-3227	Yes	Yes	310-314-3214 (V)
CompuServe	GO SPCForum	Optional*	Yes	Yes	408-980-1518
CompuServe	GO SPCForum	Optional*	Yes	Yes	408-980-1518
CompuServe	GO SPCForum	Optional*	Yes	Yes	608-277-3999
CompuServe	GO SPCForum	Optional*	Yes	Yes	608-277-3999
CompuServe; America On-line	GO Symantec	408-973-8598 (2,400-bps); 408-973-9834 (9,600-bps)	Yes	Yes	800-554-4403 (V)
CompuServe	Ventura Forum	None	Yes	Yes	619-673-7586
CompuServe	WPCS	801-225-4414 (1,200-/2,400-bps); 801-225-4444 (9,600-bps)	Yes	Yes	800-228-9960 (V)
CompuServe	WPCS	801-225-4414 (1,200-/2,400-bps); 801-225-4444 (9,600-bps)	Yes	Yes	800-228-9960 (V)
CompuServe	WPCS	801-225-4414 (1,200-/2,400-bps), 801-225-4444 (9,600-bps)	Yes	Yes	800-228-9960 (V)
CompuServe	GO WordStar	404-514-6332	No	No	404 514-6333 (V)

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9553 LTE Lite/25C with 120 MB ... 3499.
11590 LTE Lite/25E with 120 MB, Windows ... 2999.
11453 DESKPRO 4/25is with 120 MB, Windows ... 1499.
11452 DESKPRO 4/25is with 240 MB, Windows ... 1679.
11644 DESKPRO 4/50M with 340 MB, Windows ... 3349.
11645 DESKPRO 4/66M *(Hard Drive not included)* .. 2649.
11646 DESKPRO 4/66M with 510 MB, Windows ... 3649.
Monitors not included

BUSINESS APPLICATIONS

Approach Software

3830 Approach 2.0 for Windows Competitive Upgrade 95

Automap

2729 Automap USA for DOS.. 55. 8569 Windows.. 55.

Baler Software Corporation

11312 Baler 6.0. ... 279 11314 BalerExpress ... 95.

Banner Blue Software

2088 Org Plus 2.0 for Windows ... 125.

Borland International

10616 Quattro Pro Win.*(3½" only)* .. *while supplies last* 95.
10710 Paradox Windows *(3½" only)* *while supplies last* 129
11915 Office for Windows *(3½" only)* ... 395
11978 Office for Windows Comp. Upgrd *(3½" only)* 299

Caere

8933 OmniPage Pro 2.1 ... 629

Claris Corporation

10996 ClarisWorks Win 95 5257 FileMaker Pro Win. 119
5228 FileMaker Pro for Windows Competitive Upgrade.. 89

Intuit

2426 Quicken 5.0..... 45. 5596 for Windows ..... 45.

LaserTools

6882 PrintCache 3.1 ... 49.

Fractal Design

4456 Painter 2.0 for Windows -Turns your computer into an expressive fine-arts tool. Whether it is texture, color, or renowned Artists' Technique (e.g. Van Gogh), this program can accommodate your needs..... **$259.**

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3424 1-2-3 4.0 for Windows Upgrade *(3428 3½")* ... 99
1847 Ami Pro 3.0 Competitive Upgrade ... 99
10753 Improv for Windows *(3½" only)* ... *intro. price* 99
5981 SmartSuite *(5982 3½")* ... 469

MECA

2798 Managing Your Money 9.0 ... 32.

Microsoft

11324 MS-DOS 6.0 Upgrade ... 47.
3881 Word for Windows 2.0C Comp. Upgrd *(7841 3½")* 125
5693 Excel 4.0 Competitive Upgrade *(5695 3½")* 125
8355 Access for Windows *(8326 3½")* ... call
10056 FoxPro 2.5 for Windows *(10057 3½")* ... 299
8137 Office 3.0 for Windows *(8138 3½")* ... 449

Nolo Press

2982 WillMaker 4.01 ... 35.

Peachtree

5757 Accounting for Windows Release 2 ... 115

Polaris Software

4395 PackRat 5.0 ... 249

TIMESLIPS

5698 Timeslips Release 5 1.0 ... 189.

WordPerfect Corporation

7582 Presentations 2.0 *(3½" only)* ... 279.
3804 WordPerfect 6.0 for DOS *(3795 3½")* ... 279.
3494 WordPerfect 5.2 for Windows *(3497 3½")* ... 279
4786 WordPerfect for Windows Ver. Upgrd. *(4795 3½")* 79

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Adobe Systems

10774 Adobe Photoshop 2.5 for Windows *(3½" only)* . 548
6591 Adobe Illustrator 4.0 for Windows *(6439 3½")*. 429
(Entire Adobe Type Library available)

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11452 *DESKPRO 4/25is with 240 MB*—25MHz 486SX; 240 MB hard drive; 4 MB RAM upgradable to 32 MB; QVision video controller with 512K upgradable to 1 MB; Business Audio. DOS and Windows monitor not incl., **$1679.**

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Aldus

11038 PhotoStyler Win. Comp. Upgrd. *(11037 3½")*.. 189.
11667 PageMaker 5.0 for Windows *(3½" only)* 579

Altsys Corporation

8675 Fontographer for Windows 3.5 *(3½" only)*..... 259.

Application Techniques

1214 Pizazz Plus 3.0 ... 79.

Ares Software

6030 FontMonger 1.0.7 for Windows ... 89.

Bitstream

8040 FaceLift 2.0 for WordPerfect 5.0/5.1 *(3½" only)*. 69.
2089 MakeUp 1.1 for Windows ... 79.

Corel Systems

11904 CorelDRAW! 4.0 *(11896 3½")* ... 399
7922 CorelDRAW! 4.0 Upgrade *(7923 3½")* ... 225

DeltaPoint

5172 FreezeFrame 1.0 for Windows ... 62

Fractal Design

7822 Sketcher 1.0 for Win 94. 4356 Painter 2.0 259.

Inset Systems

7298 HiJaak 2.1.. 99. 3820 1.0 for Windows ..... 99.

Lotus

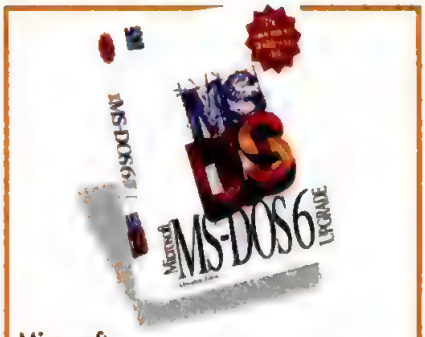
3523 Freelance Graphics 2.0 for Windows *(5005 3½")* 349

Micrografx

3627 Windows Draw! 3.0 *(3628 3½")* 99

Microsoft

10051 Font Pack 2 for Windows ... 45
3337 Publisher 1.0 for Windows 129



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11324 *MS-DOS 6 Upgrade*—The easy way to back up, virus-protect, undelete, and double your disk. Additional features that protect your data and optimize PC memory (11325 3½") ... **$47.**

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5426 Visio 1.0 for Windows *(3½" only)* ... 199.

Software Publishing

4403 Harvard Graphics for Windows *(4402 3½")* ... 369.

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12029 Double Tools for DoubleSpace ... 65.

Avery Dennison

6006 Label Pro 1.6 *(Laser)* ... 49.

Berkeley Systems

9885 After Dark 2.0 for Windows ... 29
6649 Star Trek The Screen Saver *(3½" only)*. ... 34.

Central Point Software

11393 Safe Six for Windows 1.0 *(3½" only)* ... 37.
9751 Anti-Virus 1.4 *(9555 3½")* or 8114 Backup 7.1 *ea.* 89.
5039 PC Tools 8.0a.. 125. 11394 for Windows 125.

Fifth Generation Systems

3950 Fastback Plus 6.0.. 95. 6431 for Windows 95

Gibson Research

9832 SpinRite 3.1 ... 85.

Hewlett-Packard

8731 Dashboard 1.0 for Windows ... 45

Microsoft

7010 Windows 3.1 *(7009 3½")* 89
1624 Visual Basic 3.0 Windows Std Ed *(10154 3½")* 129
11444 Visual C++ Standard Edition *(3½" only)* ... 129

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4925 PC-Kwik Power Pak 3.0 w/Power Disk *(8004 3½")* 79.

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9288 Laptop UltraVision 2.11 *(3½" only)* ... 59.

Qualitas

7539 386MAX 7.0 ... 59.

Quarterdeck

3221 Expanded Memory Manager 386 6.0 *(3217 3½")* 59.
4586 DESQview 386 2.4 *(4585 3½")* ... 129.

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6649 *Star Trek 1.0 for Windows (3½" only)*... **34.**

... **29.**

Stac Electronics

1409 Stacker 3.1 ... 95.

Symantec

11518 Norton Speedcache + 4.0 ... 65.
2359 The Norton Desktop 2.2 for Windows *(2360 3½")* 115
3146 The Norton Utilities 7.0 *(5136 3½")*... 115.
8378 Norton pcANYWHERE 4.5 *(8535 3½")*... 119.
11304 pcANYWHERE 1.0 for Windows *(11303 3½")*.. 129.

TouchStone Software

11665 Check It Pro: Set Volume II ... 79.

XTree

8328 XTree 1.5 for Win 65. 6161 XTree Gold 2.5 95.

NETWORKING/COMMUNICATIONS

3 Com ... lifetime (conditional)

3453 EtherLink II/16... 159. 3489 II/16 TP ... 169.

Artisoft

2455 Lantastic AE-2 EtherNet Starter Kit 4.1... 469.
2452 AE-2 EtherNet Adapter Card... 199.

BOCA Research ... 5 years

8397 M1440I FaxModem... 189. 8398 M1440E... 219.

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4130 FaxMaster 1.0 ... 95.

Cardinal ... lifetime

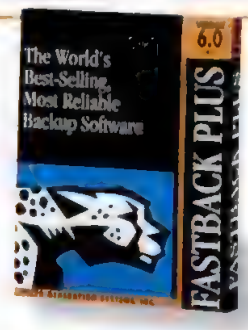
8690 MVP24I Modem Value Pack ... 35.
11634 MVP1441F FaxModem Value Pack ... 179.

CompuServe

10957 Windows Membership Kit 1.0 ... 27.

Data Storm

4798 PROCOMM PLUS 2.01 69. 6918 for Windows 99.



Fifth Generation Systems

3950 *Fastback Plus 6.0*—Includes a new easy-to-use interface, a file viewer, QIC and SCSI tape drive support, virus detection and removal. Also backs up PC's and notebooks to tape drives across a network **$95.**

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5611 Crosstalk 2.0 for Windows ...

Delrina Technology

5974 DOSFax PRO 49. 2446 WinFax PR...
10454 Windows Communications PAK ...

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11396 Accura 14.4 + Fax 14.4 *(external)*... 249
11397 Accura 14.4 + Fax 14.4 *(internal)*... 225
7391 ULTRA 96 Modem.. 599. 5024 ULTRA 144 669
7395 OPTIMA 144+FAX144 ... 389

Intel ... 3 years

10436 SatisFAXtion Modem/300 ... 239
5994 Modem/400..... 399. 5995 Modem/400e 399
2994 EtherExpress 16 or 3021 16 TP... ea 129
10913 EtherExpress 16C ... 129

Megahertz ... 5 years

10515 C5144 14.4 Fax/Modem *(Compaq LTE Contura)* 499
10517 C524FM Fax/Modem *(Compaq LTE/Contura)*... 215
11817 XJ124FM 24/96 Fax/Modem *(PCMCIA card)* 289

Microcom

6234 CarbonCopy Plus 6.1 129. 4410 W...

Microsoft

6141 Windows for Workgroups Add-on *(61...*

Norton-Lambert

2753 Close-Up Dual Pack 4.0 *(2754 3½")* ...

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12058 NetWare 4.0 *(10 user)* 1989. 12056 *(25 user)* 2899
4000 NetWare Lite *(4005 3½")*... 55.
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3803 PM14400FX *(internal modem/fax)*... 199.
9234 PM14400FXPPM Pocket Fax/Modem ... 359.
10570 PM14400FXMT *(external modem/fax)*... 215.
2425 PM14400FX SA ... 399.

Shiva

NetModem/E for Windows for Workgroups ea. 1479

Softnet

5883 FaxWorks 2.5 *(Windows & DOS) (3½" only)*... 45

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11441 SupraFaxModem V.32bis Ext. for DOS ... 299.
11442 SupraFaxModem V 32bis Ext. for Windows ... 299

Technology Concepts ... 2 years

6315 Fax Line Manager 203 ... 125.

TheComplete PC ... 2 years

5828 TheComplete Communicator ... 299.
8593 TheComplete Communicator Gold... 389.

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4407 LapLink V ... 99

U.S. Robotics

11923 Sportster 14.4 FaxModem Internal... 185.
11924 Sportster 14.4 FaxModem External ... 215.
11922 WorldPort 14.4 Pocket FaxModem ... 439.

Zoom Telephonics ... 7 years

1494 Ext. 9600V.32..... 195. 3075 Internal..... 179.
3386 FaxModem AFX 24/96/48 *(internal)* ... 49.
4430 FaxModem AFX *(2400 baud 96S/48R)*... 69.
4429 FaxModem VFP V.32bis 14,400 baud *(internal)* 189.
4428 FaxModem VFX V.32bis 14,400 baud *(external)* 215.
7921 Pocket FaxModem 24/96/48 ... 87.

VIDEO & SOUND

ATI Technologies ... 5 years

8463 VGA Wonder XL24 149. 2012 Graphics Ultra 209.
3886 Graphics Ultra + 339. 3871 Graphics Ultra Pro 519.
11022 Graphics Ultra Pro EISA *(with 2 MB)*... 579.

Boca Research ... 5 years

10468 SVGAX3 *(with Bit BCT acceleration)*... 129.
10468 SuperVGA X3... 129.

Creative Labs ... 1 year

5770 Sound Blaster 16... 229.
10906 VideoSpigot for Windows ... 429.

Diamond Computer ... 5 years

11461 SpeedStar Pro..... 125. 10079 Stealth 24 .. 165.
11306 Stealth Pro 1 MB.... 249. 11305 2 MB..... 339.

Hauppauge Computer ... 1 year

10593 Win/TV, Microsoft Video for Windows Bundle.. 459.

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Intel ... 3 years

11587 Smart Video Recorder... 499.

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11700 HD-6 speakers *(with equalizer & AC Adapter)*... 79.

Logitech ... 2 years

11462 SoundMan 16... 175.

MediaVision ... 1 year

5637 ProAudio Spectrum 16 *(3 yr.)*... 169.
11478 ProMovie Spectrum 299. 10735 CDPCXL 1099.
12028 ProAudio Studio ... 219.

NEC ... 2 years

4252 MultiSync 3FGX Monitor *(14")*... 689.
4249 4FG Monitor *(15")*.... 799. 3151 5FG *(17")* 1449.

Video Seven ... 7 years

7362 WIN VGA 1 MB 99. 11647 WIN SWIFT.. 145.
9261 WIN.PRO 1 MB... 179.

INPUT/OUTPUT

Canon ... 1 year

7893 BJ10EX BubbleJet Printer *(white)*... 255.
7809 BJ-200 BubbleJet Printer ... 355.
8940 BJC-800 Color Printer ... 1599.

CoStar ... 1 year

1814 LabelWriter II Plus... 239.

Epson ... 2 years

5555 AP-3250 *(80 col., 200 cps, 24 pin)*... 199.
11800 LQ570+ *(80 col., 269 cps)*... 269.
11495 Stylus 800 InkJet *(1 year warranty)*... 369.
10784 Action Laser 1500 *(1 MB)* ... 789.

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6275 *WordPerfect 6.0 DOS Version Upgrade*—Character-based or graphical interface. Built-in spreadsheet, merging, fax/modem support and Grammatik 5. Much more *(6274 3½")*.... **$99.**

3804 *WordPerfect 6.0 DOS* (3795 3½") .... **279.**

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11924 *Sportster 14.4 FaxModem External*.. **215.**

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6442 LaserJet 4 *(with toner)* ..... 1499.
7970 LaserJet 4 Toner... 109. 11884 *(3 Pack)*.... 319.

Kensington Microware ... 1 year

7899 Expert Mouse *serial*... 99. 7900 *bus*..... 115.

Key Tronic ... 3 years

4518 101 Plus Keyboard ..... 99.

Logitech ... limited lifetime

3998 Trackman2 *(combo)*... 79. 2343 Portable..... 99.
3295 Mouseman *(combo)*.... 69. 9766 *(cordless)* .... 89.
7975 ScanMan256 ..... 239.

Microsoft ... lifetime

7597 Microsoft Serial Mouse 2.0 ..... 77.
1896 Ballpoint Mouse *(serial only)* ..... 119.
2898 Mouse with Windows 3.1 *(bus or serial)* 145

MicroSpeed ... 1 year

11222 KB101 Keyboard ..... 40.
6007 PC-TRAC Trackball *serial* ..... 75.

Microtek ... 1 year

5187 ScanMaker II 879. 5175 ScanMaker IIxe. 1099.
11859 ScanMaker II with Transparency ..... 1449.

Mouse Systems ... lifetime

7878 PC Mouse III *(serial)*.. 89. 5427 NewMouse .. 62.

Mustek ... 1 year

8452 Gray Artist for Windows *(256 GS hand scanner)* 165

Okidata ... 1 year

5093 OL400 Laser Printer 599. 9590 OL810 Laser 1089.
11901 OL830 Plus 1149. 11893 OL850..... 1279.

Pacific Data ... lifetime/60 day MBG

5729 ProTracer *(personal CAD printer) (1 yr.)*..... 1099.

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American Power ... 2 years

7108 Smart UPS 400.... 339. 7105 Smart 600.... 439.
3819 Back-UPS 250..... 115. 3858 Back 400..... 179.
7107 Back-UPS 450..... 215. 3823 Back 600..... 295.

Software Marketing

11856 *B.A.B.Y.—Birth And Baby Years*—Celebrate the miracle of life with B.A.B.Y., a computerized guide that leads you from pre-pregnancy to after your child is born..... **$36.**

Curtis ... lifetime

7358 Command Center SPF-4 ..... $79.

Cyrix Corporation ... 5 years

9909 83D87-40..... 77. 9876 83D87-33..... 65.

Intel ... 3 years

4750 80387SX 79. 5409 80367DX 85. 6569 80387SL 79.

I/O Designs ... lifetime

11371 Ultimate Laptop XL Carry Case ..... 65.

Kensington Microware ... 1 year

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4973 Power Tree 20 ..... 24.
7060 MicroSaver Security System ..... 39.
2582 MasterPiece Plus..... 95. 2587 Remote..... 105.

PC Power & Cooling ... 2 years

9537 CPU Cooler *(for 386/33 up to 486)* ..... 29.
3203 Turbo Cool 200 149. 7915 Turbo Cool 300 159.

Targus ... lifetime

7369 Notepac..... 35.
1305 Universal Notebook Computer Case..... 69.

Tripp Lite ... 2 years

6199 Isobar 4-6 *(4 outlets, Gold Seal Warranty)*..... 43.
6200 Isobar 6-6 *(6 outlets, Gold Seal Warranty)*..... 49.
5550 BC250 Battery Backup ..... 119.
9312 BC500 Power Backup ..... 219.

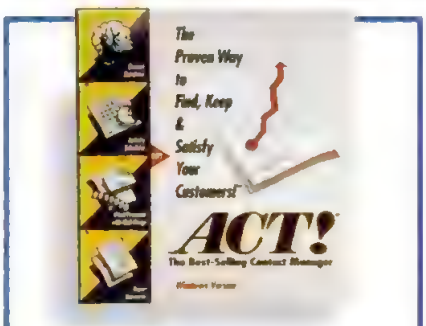
DRIVES

Colorado Memory Systems ... 1 year

4354 Jumbo 250 Tape Backup ..... 215.
1073 Trakker 250 Tape Backup *(parallel)*..... 429.

Conner Peripherals ... 1 year

2339 CP30104H 120 MB IDE HD *(19 ms)*..... 269.
1337 CP30204 210 MB IDE HD *(16 ms)* ..... 349.



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7435 *ACT! for Windows*—Put everything you know about customers, prospects, and associates into customizable, dBASE-compatible files. Also an activity scheduler, WYSIWYG word processor, and a report writer..... **$239.**

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10103 F21 MB Floptical *(internal)*..... 419.
6499 Transportable 90 PRO ..... 659.
10452 Transportable MultiDisk 150 ..... 849.
6344 PC Powered 90 PRO ..... 599.
10537 PC Powered 150 ..... 799.
2530 90 MB Cartridge..... 149. 2467 Tripak ..... 439.
8480 Tape250 Insider Tape Backup ..... 199.
8481 Tape250 Inside Half-Height Tape Backup ..... 209.
10702 Tape250 Parallel Port Tape Backup ..... 429.
8482 Tape250 PC Powered Tape Backup..... 319.

NEC ... 2 years

6582 CDR74-1 CD-ROM Drive ..... 629.
6581 CDR84 Internal CD-ROM *(reqs. interface)* ..... 569.

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8267 Plus Hardcard II XL 105 MB *(9 ms)* ..... 279.
4735 Hardcard EZ 127 MB IDE *(17 ms)*..... 329.
4714 Hardcard EZ 240 MB IDE *(16 ms)*..... 549.

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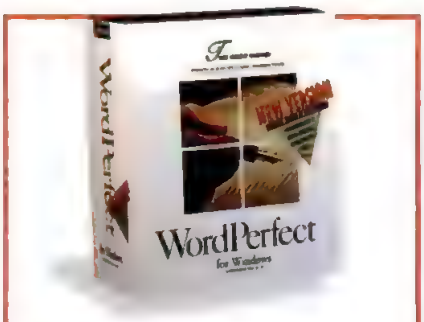

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Fuji ... lifetime

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11790 3.5" HD Disks *(10)*..... 13.
4863 3.5" HD Disks *(20)* with storage case..... 25.

Kao

11870 3.5" HD Disks *(10)*..... 12. 11869 *(30)* ..... 35.
11867 3.5" HD Disks *(50)*..... 50.

Sony ... lifetime

3292 5.25" HD Disks *(10)*..... 11.
3297 3.5" DS Disks *(10)*..... 9. 6148 *(30)* ..... 25.
3298 3.5" HD Disks *(10)*..... 14. 6375 *(30)* ..... 39.
1603 DG60M..... 15. 2520 DG90M..... 19.
8185 QD2040..... 14. 1895 QD2120..... 19.

3M ... lifetime

1581 DC2120..... 22. 11013 *(3 pack)*..... 60.

Toshiba ... lifetime

4858 3.5" 2.88 MB ED Disks *(5)*... 17. 9755 *(10)*.. 29.

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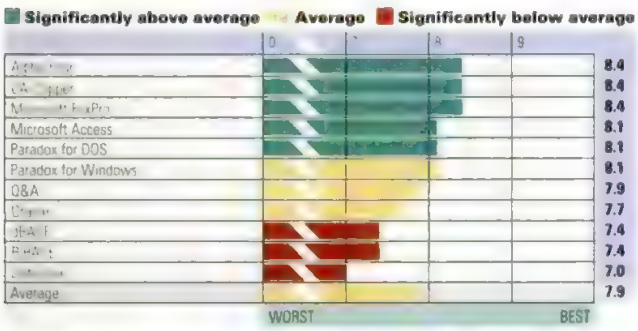
How Readers Rated the Software:
Databases



DOS apps have a strong showing among our database users. They gave high marks to Alpha Four, CA-Clipper, Microsoft FoxPro, and Paradox for DOS, but Microsoft's Windows-based Access also got a nod.

good on a promise by Ashton-Tate Corp. to deliver a dBASE compiler as well, although these two came through too late for this study. Oracle Corp., too, should have a long-awaited new version by the time you read this.

Supporting database software—especially in the development community—is a big undertaking. Almost half of the surveyed users of databases think toll-free support important, but few of the vendors offer it. Borland and Microsoft offer free support for limited periods of time.

Database forums are among CompuServe's busiest, and survey respondents echoed their enthusiasm for on-line support, both there and on private, vendor-supported bulletin boards. Although a relatively small portion of users rated these on-line services "very important," virtually all of the vendors sponsor a CompuServe forum, and many have private BBSs.

Paid (premium) support may be valued more highly by users in this category than in any other. Database support for complex installations in large organizations is not quite so easy as maintaining support for standalone, end user products. Oracle users in particular expressed interest in paid (premium) support. Microsoft recently launched similar support initiatives, partly to pair Access with Microsoft SQL Server. Borland has also boosted this priority as it aims for more corporate business, so paid (premium) support may be more important in the future.

Contrasted with other categories, database users seemed to be a bit more dissatisfied with written documentation, though that still had one of the highest averages within the database technical support category. Still, this was not an overwhelming vote of confidence. Compared with users' satisfaction in documentation for spreadsheets, word processors, and graphics, this score is a bit on the low side. Database products are often geared towards developers; they tend to be document-dependent.

Most Access users rated the manuals "very important" and were satisfied. They also reacted favorably to the built-in help. Paradox for Windows users gave the product an average rating for documentaton; perhaps the leap from DOS to Windows set high expectations.

This is a broad category with a diverse user population. Graphical environments, client-server architectures, and connectivity issues only continue to stir up the brew.

H I G H L I G H T S

Graphics

For now, at least, graphics has a hands-down winner in both support and satisfaction—CorelDRAW. The graphics category is so diverse that in sheer numbers of products it is one of the most densely populated in this survey. It is also the category with the greatest breadth of products. The lineup includes desktop publishing programs such as Xerox Corp.'s Ventura Publisher andAldus PageMaker, as well as presentation graphics programs such as Software Publishing Corp.'s Harvard Graphics (both for DOS and for Windows) and sophisticated illustration tools like CorelDRAW and Designer from Micrografx. But it was clearly and expectedly GUI-dominated.

How Readers Rated Technical Support:
Databases

■ Significantly above average
Average
■ Significantly below average

	Satisfaction with support	800-number support	Free support via toll number	Paid (premium) service	Documentation	CompuServe	Vendor BBS	Built-in help	Tutorials	Replacement of defective disks
Paradox for Windows	87■	82■	79■	68	76	87■	79	73■	72	88
Q&A	81■	69	71	58	77■	66	66	73■	75■	89
Alpha Four	78■	66	68	53	80■	72	70	73■	80■	89
Microsoft FoxPro	78■	71	72■	72	75■	80■	68	72■	69	89
Paradox for DOS	78■	72	73■	67	77■	79■	73	66	66	87
Microsoft Access	77	72	70	72	75■	75	76	81■	78■	94■
Oracle	72	68	64	73	67	72	66	51■	52■	82
CA-Clipper	70■	56■	61	67	65■	82■	88■	56■	51■	83
dBASE	70■	69	66	63	68■	72	65	59■	63■	81
R:BASE	68■	63	56■	68	71	63	65	65	66	75
DataEase	63■	63	42■	51	66■	30■	50	46■	57	87
Average	75	66	66	65	72	77	70	65	66	86

Readers gave Paradox for Windows a significantly above-average score for technical support, although it was in the average range for overall satisfaction.

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■ Significantly above average
Average
■ Significantly below average

How Readers Rated Technical Support: Graphics

	Satisfaction with support	800-number support	Free support via toll number	Paid (premium) service	Documentation	CompuServe	Vendor BBS	Built-in help	Tutorials	Replacement of defective disks
CorelDRAW	81■	72	74	76■	78■	83■	73	72■	74■	89
Designer	79	73	78	60	72	80	68	67	67	92
Microsoft PowerPoint	79	67	70	61	76■	71	65	73■	74■	92
Windows Draw	79	85■	79	60	75	56	55	73■	75	87
Harvard Graphics for Windows	78	77	68	61	73	64	63	68	70	77
Aldus PageMaker	76	74	72	73	76	71	61	69	70	84
Lotus Freelance Graphics for Windows	76	73	68	68	73	76	73	74■	76■	92
Harvard Graphics for DOS	74■	73	70	65	71■	73	67	63■	64■	82
Lotus Freelance Graphics for DOS	73	76	64	55	71	80	59	60■	64■	75
Ventura Publisher	70■	73	60	63	74	79	69	61■	66	88
Average	76	74	70	64	74	73	65	68	70	86

CorelDRAW was the only standout for satisfaction with technical support. Readers also gave high marks to toll-free support for Windows Draw, from Micrografx.

At this drawing board, Corel rules. The Windows-based drawing package (updated this past year and recently updated again) swept the ratings for overall satisfaction and overall technical support and fared very well in individual tech support categories, including documentation, built-in support, tutorials, and on-line support.

Reversing last year's survey results, long-time market leader Harvard Graphics weighed in significantly below average on the satisfaction scale, although the DOS version still had twice as many respondents as any other package. The aging Freelance Graphics for DOS from Lotus Development Corp. was also rated significantly below average on our overall satisfaction poll. Windows Draw and Designer, both from Micrografx, got average ratings. Harvard Graphics for Windows got significantly less than average marks in overall satisfaction, although satisfaction with technical support was within the average.

An interesting policy of graphics vendors is the almost complete absence of toll-free tech support. Nearly half of the graphics users in our poll (45 percent) rated this service as highly important. Interestingly, Lotus offers a toll-free technical support line to users of its products for 90 days. Participants in our survey, however, did not seem to give this any special notice.

CorelDRAW has done an admirable job of attracting both market share and user satisfaction.

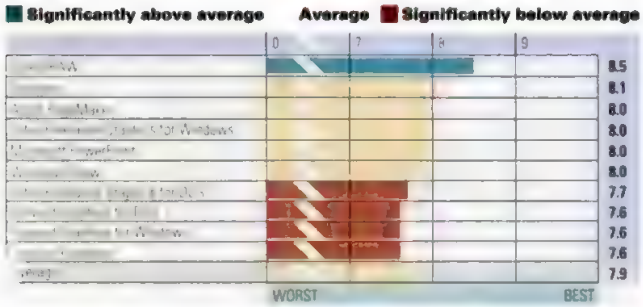
Micrografx's Draw is the hands-down winner in free technical support by phone. Interestingly, though, while more than half of those using Micrografx's Designer rated phone support as highly important, a mere third of those using Micrografx's Draw felt the same way. 49 percent of the CorelDRAW users rated it as highly important. Draw is targeted at the business user rather than the professional designer, so the numbers make good sense. Designer was also one of the very first Windows graphics packages; the product's users may be veterans who don't need frequent help.

Graphics users don't seem to be particularly concerned with on-line support, either through private BBSs (which few of the vendors maintain) or on CompuServe (which draws wide participation by vendors). Only 6 percent of the respondents rated on-line support as highly important.

In this rather eclectic category, however, almost every product had a shot at the spotlight somewhere. Freelance for Windows users rated the product as average in many features, but, like Microsoft PowerPoint users, they appreciated the product's built-in help. The Freelance DOS counterpart, however, ended up with a below average score for its built-in help.

CorelDRAW has done an admirable job of attracting both market share and user satisfaction. The Toronto-based Corel Systems Corp. continues to add to the vast capabilities of this premier product. It will be interesting to watch and see whether Corel Systems can maintain this dominance. □

How Readers Rated the Software: Graphics



CorelDRAW was the only graphics program that users rated significantly above average. This diverse category included everything from desktop publishers to paint programs.

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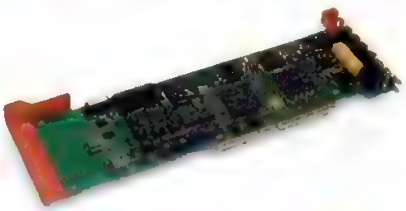

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CIRCLE 098 ON READER SERVICE CARD

TROUBLESHOOTING YOUR LAN

Cable Detectives

by Barry Nance

Seventy percent of LAN failures are caused by problems with the cabling, by most estimates. On the case are cable testers. Here are five for under $5,000.

It's 3:17 in the afternoon. Your network is going down. Error messages are popping up at workstations as they drop from the LAN. There are sudden, inexplicable pauses in network response. You watch your network mapping software as workstations disappear from the on-screen map. As the LAN manager, you must act quickly, hunting down and identifying the mysterious villain that is crashing your network.

Some of the instruments you keep at hand to tackle such a problem and restore order are a spare network adapter, a boot floppy disk containing network shell software, and perhaps one of the low-cost protocol analyzers reviewed in our issue of January 12, 1993. Another instrument you should have close by is a cable tester.

Less expensive than a protocol analyzer, a cable tester is several steps up technically from the simple ohmmeter. Moreover, although an ohmmeter costs substantially less, can measure the resistance of a wire, and can indicate if a line is broken, even a high-quality ohmmeter cannot give the location of the break.

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Illustration by Mick Wiggins

HIGHLIGHTS

Cable Testers

NETWORK CABLING PROBLEMS cause about 70 percent of LAN downtime, so investing in the right cable tester is a good idea. A cable tester can locate wiring problems and verify the quality of newly installed cabling. Perhaps one of your network cables is too long or has an internal fault. That fault could be a broken wire or a short circuit, or it might result from excessive electrical interference, a bad connector, or a missing terminator. Problems can crop up at any time. Although most develop months or years down the line, some can be introduced during installation. A cable tester can pinpoint problem areas and also reveal them before they cause trouble.

THE HEART of a cable tester is a TDR, which works on the same principle as sonar or radar. The TDR sends an electrical pulse down a network cable and listens to the reflection. Because electricity travels at different speeds through different cables, a TDR's distance calculations depend on its knowing the nominal velocity of propagation (NVP) for the specific cable type you're testing. (Generally, the NVP, characteristic to each type of cable, is expressed as a percentage or fraction of the speed of light in a vacuum.) Alternately, you may enter an NVP value after calibrating the cable manually.

OF THE FIVE CABLE TESTERS we reviewed, the Microtest MT350 Scanner is the most versatile, with its database of more than 80 NVP values, covering nearly every cable ever constructed. The Fluke 650 LAN CableMeter holds 12 preprogrammed values, and Wavetek's LANTech 10 carries 18. The Microtest MT310 Scanner and Scope's WireScope 16 have no stored values, but all five accept custom NVPs.

SOME CABLE TESTERS perform more tests than others. If a cable problem is caused simply by a broken wire or short circuit, any cable tester should be able to find the fault. But if your cable's problems are caused by electrical interference or crosstalk, you'll need a unit designed to detect such LAN-crippling noise. A cable tester's ability to reveal live LAN traffic statistics and perform rudimentary protocol analysis is a new trend in cable testing technology (see The Future of Cable Testers for more information).

MOST CABLE TESTERS will print a report showing test results for network cables, and reports can be uploaded to the PC for periodic examination. The printer connection is serial: you can attach the cable tester to a PC and use a communications program to upload reports into a file. Microtest's devices will even output results in comma-delimited ASCII, suitable for importing into a database manager or spreadsheet.

And, an ohmmeter doesn't measure electrical interference, called *noise*, or *NEXT* (near-end crosstalk), the noise that occurs adjacent to the connectors at either end of a cable. Protocol analyzers, for their more sophisticated ability to report on network message packets and when the packets are being damaged, cannot detect the electrical noise that may be causing the damage. Thus, having the right cable tester around could save hours or days of network downtime.

No longer the bulky, awkward apparatuses of years ago, today's cable testers are hand-held devices about the size of a Game Boy that generally ship with a few patch cables, a loopback device that attaches to the open end of the cable you're testing, and documentation. Package options might include a portable serial-port printer, PC software for maintaining a cable information database, additional cable adapters, and a spare battery.

We looked at five cable testers, each under $5,000, that work with coaxial cable and unshielded twisted-pair (UTP) wire. You can buy most of these devices with optional adapters that test shielded twisted-pair (STP) wire, which is used with Token-Ring networks. (A few of these vendors sell entire lines of cable testers.) All five can hook up to a serial-port printer to produce on-the-spot reports; Wavetek Corp. offers an optional, $495 printer for its LANTech 10. All five devices are battery powered; a few use rechargeable nickel cadmium batteries.

LOOKING FOR TROUBLE

A cable tester can detect faults that stem from an incorrect cable installation, worn insulation, or a loose connection. Ironically, one of the most frequent problems is simply a disconnected wire. Someone trips over a cable and loosens it, or detaches it to reach behind the desk and forgets to reattach it. Sometimes all it takes is a bump to the connector. Cable testers can also identify the insidious problems that develop when electrical signals within the wire interfere with each other, or when electrical devices near the cable (such as fluorescent lights or electric motors) cause disturbances that corrupt the LAN signal. These problems are examples of noise.

In addition to noise, the cable tester measures several characteristics of the cable itself to determine the location of

Our Contributors: FRANK J. DERFLER, JR., is the senior networking editor of *PC Magazine*. DAVID GREENFIELD is the senior editor for networking and communications of *PC Magazine*. ANDREW C. KANTOR is a staff editor, and ADAM HICKS is an editorial researcher at *PC Magazine*. BARRY NANCE has been a programmer for 20 years and is the author of *Introduction to Networking, Network Programming in C, Networking Windows for Workgroups,* and *Using OS/2 2.1*. GAIL SHAFFER was the associate editor in charge of this story, and RICHARD BRADY was the project leader.

a fault, including attenuation, impedance, and NEXT. *Attenuation* is the decrease in a signal's strength as it travels along a cable. Longer cables and cables that carry high frequencies experience greater attenuation. The tester measures attenuation in decibels (dB). For example, the maximum attenuation allowed for 10BaseT UTP cabling is 11.5 dB. A reading of 0 dB means no signal loss.

Impedance is more important for coaxial cable than for twisted-pair cable. The characteristic impedance of a cable (measured in ohms) is defined as the total opposition to AC current flow that a cable would have if the cable were infinitely long. The thickness (or gauge) of the copper conductors, the distance between them, and the properties of the insulation in the cable all influence impedance.

A change in the characteristic impedance of a wire somewhere along its length causes a reflection inside the cable, called a *discontinuity*. Broken wires, short circuits, and mixed wire types are but three situations that can produce discontinuities. The characteristic impedance of both thick and thin Ethernet cable is 50 ohms, and ARCnet cable has a characteristic impedance of 93 ohms.

Other suspects are *crosstalk* (the electrical interference between wire pairs in twisted-pair cable) and NEXT. A cable tester measures NEXT by transmitting a signal through one wire pair and detecting the resultant spill-over of current into the other pair. A high degree of attenuation (signal loss) between the wire pairs indicates low NEXT. Low attenuation means there is a problem. In addition, the electrical devices near LAN cable can cause noise that can damage or destroy the data flowing through the cable. A twisted-pair LAN cable acts as an antenna, picking up stray electromagnetic interference. The cable tester measures the amount of interference: Impulse noise occurs in spikes, whereas wideband noise is continuous.

A cable tester must measure up in four areas to be a worthy diagnostic tool: accuracy, range of cable types it tests, range of tests it performs, and ease of use. The cable tester must tell you exactly what and where the problem is. It must work with all the types of cable you have in your network now, and preferably with all the types you might have in the future. The cable tester must be able to detect short circuits, *opens* (or breaks), miswired cables, susceptibility to noise, and cable runs that are too long. Finally, ease of use is more important than it may seem. A network manager might put the cable tester to work infrequently or only when there is trouble, so the device must be easy to operate.

Against these criteria, the Fluke 650 LAN CableMeter stands out for its simplicity, range, and ability to detect cable problems precisely. It is the right tool for most LAN administrators whose networks use standard cable types. For the contractor or consultant who must deal with diverse networks and cabling combinations, the versatility of the Microtest MT350 Scanner makes it a good choice.

PC MAGAZINE

EDITORS' CHOICE

- **Fluke 650 LAN CableMeter**

For its blend of versatility and approachability, we find the Fluke 650 LAN CableMeter to be an all-around good choice. For the rapidly growing number of small Ethernet LANs that use thinnet or unshielded twisted-pair wiring, the Fluke 650 will serve well as a LAN administrator's first line of defense against cable problems. Its built-in list of 12 NVP values for popular cable types, plus its ability to hold another 4 custom NVP values (that you measure and store), is perfectly adequate for the vast majority of cable-testing chores most LAN managers are likely to encounter. Its documentation is better than average, and the Fluke 650's rotary dial was the easiest interface to use; the results it displays on a 4-line by 16-character LCD screen are easy to interpret.

One interesting feature of the Fluke 650 is its automatic reset. Every time you connect a cable to the unit, it detects the new connection and resets itself for the next round of testing. It then promptly delivers accurate results (as long as you have correctly designated the type of cable being tested). Whether the problem is simply a broken wire inside a cable, unacceptable electrical noise and interference, or a jabbering network adapter on the LAN, the Fluke 650 is a good tool for locating the cause. Battery life varies with the testing you do and the age of the batteries, but the unit we tested lasted through almost 8 hours of continuous use.

The Fluke 650's ability to store and later print cable test results for as many as 50 cables is handy and will help you inventory and monitor your network cabling. Reviewing the printouts you accumulate might help you spot a fault before it brings down your entire network. The Fluke 650 makes a potentially important maintenance chore less of a burden.

TACKLING CABLE MYSTERIES

A cable tester uses a time domain reflectometer (TDR) and perhaps additional test circuits to perform its investigations. The TDR sends sonar-like pulses through the LAN cable, detects the reflections, analyzes them, and displays the results. Using the reflections, the cable tester can typically report on the cable length, whether the cable is correctly wired internally (pin-to-pin wire mapping), whether it contains a short circuit (wires touching each other through damaged or missing insulation) or an open, or whether the cable suffers from electrical interference. Any one of these situations can bring down your network.

Cable problems can be introduced in various ways, and they may take months or years to develop to the point where they cause a network outage. Short cir-

Glossary of Cabling Terms

ARCnet An older token-passing LAN standard developed by Datapoint Corp. ARCnet (Attached Resource Computer Network) uses RG-62 coaxial or twisted-pair cable. ARCnet LANs, usually star-wired with central hubs, can also use a bus topology.

attenuation A measure, in decibels, of the loss in strength (amplitude) that an electrical signal experiences as the signal travels through a wire.

BNC connector A connector for thin coaxial cable. BNC connectors use a bayonet lock to connect to a T-connector.

characteristic impedance The total opposition, measured in ohms, to the flow of alternating current that a wire would exhibit if it were infinitely long.

coaxial cable A type of cable with an inner copper conductor surrounded by a tube-shaped second conductor; the second conductor helps act as a shield. Coaxial cable is commonly associated with Ethernet, specifically **10Base2** and **10Base5**.

crosstalk The electrical interference that results when one wire's signal affects another wire's signal. Unshielded twisted-pair cable is more subject to crosstalk than are coaxial or shielded twisted-pair cable.

dB (decibels) The unit of measure for the amplitude (strength) of a signal, often associated with sound.

dielectric insulation A kind of shielding surrounding the copper wires in a cable, usually a type of plastic. The type of dielectric insulation influences a cable's susceptibility to electrical noise, and affects the cable's NVP.

impedance The resistance of a wire to the flow of alternating current. Mismatches in impedance along a cable cause distortions and reflections.

loopback device A part of the cable test unit that takes a signal transmitted through a cable by the cable tester and returns it to the tester for analysis.

NEXT (near-end crosstalk) The interference that occurs adjacent to the connector at either end of the cable. NEXT is measured close to the source of the test signal.

noise The electrical interference that garbles the data signal passing through a cable. The interference can come from external electrical devices, such as motors and fluorescent lights, or from other wires inside the cable.

NVP (nominal velocity of propagation) The speed at which a signal flows through a cable, expressed as a fraction or percentage of the speed of light in a vacuum. Cable testers use this speed, along with the amount of time it takes for a signal to reflect back to the testing device, to calculate the length of a cable.

open A break in a cable circuit.

resistance The degree to which a wire opposes the flow of electricity in a cable, measured in ohms.

reversed pairs A miswiring of a connector in a way that causes one of the wire pairs to carry a signal that the other wire pair should carry.

RG-58 50-ohm coaxial cable for 10Base2 networks.

RG-59 75-ohm coaxial cable for ARCnet or CATV LANs.

RG-62 93-ohm coaxial cable for IBM terminals or ARCnet LANs.

RJ-45 An 8-pin telephone jack connector commonly used with unshielded twisted-pair cable.

shielded twisted-pair (STP) A specially insulated cable whose wires have a minimum number of twists per foot. The greater the number of twists, the lower the crosstalk. STP wiring is commonly associated with Token-Ring networks.

shiner A condition in which a portion of the insulation that surrounds a cable is scraped off, thus exposing the copper wire; this usually leads to cable failure.

short circuit The condition of having a circuit completed at a point too close to the origin, often resulting in power surges and damage to the system. A short circuit can also be created when two wires are touching in a cable circuit.

T-connector A T-shaped connector for coaxial cable. Each end of a T-connector attaches to an Ethernet network adapter. At either end of the network, the unused sides of the T-connectors are attached to terminators.

10Base2 The IEEE standard for Ethernet over thin coaxial cable (RG-58), sometimes called thinnet or cheapernet wire. 10Base2 limits cable to 185 meters (about 600 feet) per segment. A T-connector attaches the thin coaxial cable to a BNC connector on an Ethernet adapter. 10Base2 is a linear bus topology in which the cable snakes from PC to PC over the LAN.

10Base5 The IEEE standard for Ethernet over thick coaxial cable (thicknet). 10Base5 cable segments can be up to 500 meters (about 1,625 feet) long. The cable attaches an Ethernet network adapter to a 10Base5 network with a transceiver and a vampire (piercing) connector. 10Base5 is a linear bus topology.

10BaseT The IEEE standard for Ethernet over unshielded twisted-pair cable. 10BaseT has a cable-length limitation of 100 meters (about 325 feet). 10BaseT uses an RJ-45 connector to attach the unshielded twisted-pair wire to an Ethernet network adapter. 10BaseT uses a star-wired topology in which each Ethernet network adapter is cabled to a central hub.

TDR (time-domain reflectometer) A sonar- or radar-like diagnostic technique that analyzes reflected electrical pulses to detect cable faults. A TDR measures the length of a cable by measuring the time it takes for the reflected pulse to return to the TDR, multiplied by the nominal velocity of propagation.

terminator A resistor, usually 50 ohms, connected to either end of a thin Ethernet coaxial cable. The terminator matches the characteristic impedance of the cable and dissipates the electrical signal, preventing reflections.

thicknet A standard coaxial Ethernet cable, about as thick as your thumb.

thinnet Also referred to as cheapernet, a coaxial Ethernet cable about as thick as your little finger.

UTP (unshielded twisted-pair) A popular twisted-pair cable that looks like telephone wire and does not have an insulating shield or sheath. It is commonly associated with Ethernet (10BaseT) and Token-Ring networks.

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cuits and open connections can develop well after installation, particularly if the cable has cheap insulation, which tends to dry out and crack. Some wiring problems are actually introduced during cable manufacture and connection. In rare situations, the factory or installer will put the connectors on the cable incorrectly, with the wrong wire leading to the wrong pin, so that a brand-new cable won't work at all. Occasionally, wire pairs are mixed up by the incorrect attachment of the connectors, so that one of the wire pairs carries a signal that the other wire pair should carry (a condition known as *reversed pairs*).

Even with perfectly manufactured, carefully connected wire, things can still go wrong. During installation, a portion of the insulation around the wire might be inadvertently scraped off; such a cable is called a *shiner* and usually ends up causing a failure. Or, in planning a network installation or addition, the LAN administrator might overlook the published limitations of a wiring specification. The result could be a LAN segment with cables that are too long or that are carrying too many nodes. It's easy to overlook distance and number-of-nodes limitations when you're concentrating on giving people access to the network.

KNOW YOUR CABLING SUSPECTS

A LAN generally uses one of three distinct cable types: twisted-pair wire (shielded or unshielded), coaxial cable (thin or thick), or fiber-optic cable.

Twisted-pair is just what its name implies: insulated wires twisted together, with a minimum number of twists per foot. Twisting the wires reduces attenuation. *Shielded* refers to the type and amount of insulation around the wire and therefore the wire's noise immunity. UTP wire is commonly used by the telephone company. STP (shielded twisted-pair) cable is entirely different in appearance, looking something like the wire that carries house current (110 to 120 volts). But appearances can be deceiving. STP wire actually carries a relatively low voltage. The heavy insulation is for noise reduction, not safety.

Coaxial cable is most often found connected to the backs of television sets and audio equipment. *Thin* and *thick* refer to the cable's diameter. Standard Ethernet cable (thick Ethernet, sometimes called *thicknet*) is about as thick as your thumb, and thin Ethernet cable (sometimes called *thinnet*) is closer to that of your little finger. Thick Ethernet has a greater degree of noise immunity, is more difficult to damage, and requires a vampire tap (a piercing connector) and a drop cable to connect to the LAN through a transceiver. Thin Ethernet cable carries signals over shorter distances than thick cable. Thinnet uses a simple BNC connector, costs less, and has become a standard in-office coaxial cable.

Fiber-optic cable uses light rather than electricity to carry data signals. Fiber-optic cable is sleek in design and transmits data over long distances, but it is expensive and unforgiving of bad connections. (The cable testers for this story do not handle fiber-optic cable, although such testers are certainly available. Cabling for fiber-optic networks is more likely to be installed by a fiber-optic specialist, thereby minimizing potential cabling installation error.)

CABLES IN A LINE-UP

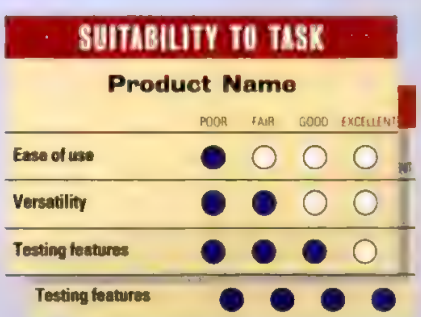
Vendors identify LAN cable types by means of various naming and numbering conventions. One common system is IBM's, which identifies STP cable as Type 1, Type 2, Type 6, Type 8, or Type 9. UTP cable is Type 3. You can buy Type 1 cable for non-plenum, plenum, and outdoor use. (A *plenum* is an air space; the wire you install in a plenum must meet specifications established in the National Electrical Code or set locally.)

Type 1 cable consists of two twisted pairs of 22-gauge solid conductors, shielded with both foil and braid, and covered with a polyvinyl chloride (PVC) sheath. Type 3 telephone twisted-pair cable, on the other hand, consists of four pairs of 24-gauge wire in PVC plastic. Type 3 is unshielded and not as immune to noise (when used for data) as is Type 1 cable. The other IBM cable categories are Type 5 (fiber-optic), Type 6 (patch-panel), Type 8 (under-carpet), and Type 9 (low-cost plenum).

Underwriter's Laboratories (UL) also puts forth a cable-grading system for both shielded and unshielded twisted-pair cable. It distinguishes such characteristics as conductor resistance, mutual capacitance, impedance, attenuation, and NEXT. The UL standard uses levels, numbered I through V, to indicate the quality of LAN cable. UL Level III wire should be adequate for use with 10-megabit-per-second Ethernet cable, whereas Level V cable should be capable of carrying 100-Mbps signals reliably.

Suitability to Task: Cable Testers

Cable testers help pinpoint the most frequent cause of network downtime: cable faults. When all or part of your network fails, you will want a tool that is easy to use, supports all the types of cable on your network, and performs the full variety of tests that may be necessary to locate and identify the problem.



If you are not a professional cable installer who uses a tester every day, **ease of use** is critical when a problem arises. A product rated as *excellent* is simple to use, comes with easy-to-follow instructions, and has a clear interface.

A cable tester's **versatility** is more important for medium- to large-scale networks, which often include a mix of cable types, than for small LANs, which generally use only a single cable type. It also comes into play for organizations that have several different LANs to manage. Choose a cable tester that supports all the types of cable you have now—and are likely to have in the future.

All cable testers can detect broken wires and short circuits, but not all network problems are that simple. In order to certify a cable as completely healthy, a unit's **testing features** must also include checks for line noise, attenuation, and other faults

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Network Cable Standards And Specifications

by Frank J. Derfler, Jr.

Different networking specifications have historically called for different types of cabling. ARCnet and Ethernet, for example, require two different types of coaxial cable, which is a single conductor surrounded by a metal braid. Token-Ring networks use shielded twisted-pair wire—two pairs of wires shielded from each other by metal foil and surrounded by another piece of foil.

Even so, designers and installers pressured vendors to come out with LAN adapters that are able to use unshielded twisted-pair (UTP) wire. (UTP wire doesn't fill wiring conduits as quickly as the other types of cable do, and it takes less training to install.) The result was a blizzard of cable choices and standards that LAN managers must still deal with today.

Agencies as diverse as Underwriters Laboratories (UL), IBM, the Electronic Industries Association/ Telecommunication Industry Association (EIA/TIA), the National Fire Protection Association, and the Institute of Electrical and Electronics Engineers (IEEE) have issued cable standards.

The table below illustrates the differences among a few of the standards and technical specifications, but some standards—particularly the UL Performance Level Marks—include more electrical and safety specifications than we can show here. Also not shown are the various fire-resistance and fume-resistance categories of the National Electrical Code that apply to the outer jackets of all cables.

The push toward unshielded twisted-pair wire resulted in a blizzard of cable choices and standards that the managers of LANs must still deal with today.

Information about impedance, a complex factor that is related to but different from resistance, is useful because various types of cables are often described in terms of their resistance (52-ohm, 100-ohm, or 150-ohm, for example). Attenuation is useful as a rough measure of a cable's quality, but unfortunately the different standards specify attenuation using disparate units of length.

NEXT is a valuable measurement for twisted-pair cables, but the numbers can be deceiving because decibels are logarithmic; for example, the difference between -56 dB of crosstalk in UL Level IV cable and -62 dB of crosstalk in UL Level V cable is 6 dB, but the crosstalk in Level V cable is only one-fourth as strong—which means a very significant increase in quality. □

Cable type	Typical application	Standards	Impedance (at 1 MHz)	Attenuation (at 1 MHz)	Worst-pair NEXT (at 1 MHz)
UTP	PBX telephone cable	UL Level I	N/A*	N/A*	N/A*
UTP	4-Mbps Token-Ring LAN	UL Level II, IBM Type 3	84–113 ohms	8 dB per 1,000 feet	Not specified
UTP	10BaseT Ethernet LAN (minimum)	UL Level III, EIA/TIA 568 Category 3	100 ohms	7.8 dB per 1,000 feet	-41 dB
UTP	10BaseT Ethernet LAN (preferred)	UL Level IV, EIA/TIA 568 Category 4	100 ohms	6.5 dB per 1,000 feet	-56 dB
UTP	FDDI 10BaseT Ethernet LAN	UL Level V, EIA/TIA 568 Category 5	100 ohms	6.3 dB per 1,000 feet	-62 dB
STP	Token-Ring LAN (4- or 16-Mbps)	IBM Types 1 and 2	150 ohms	<2.2 dB per 100 meters	-58 dB
		IBM Types 6 and 9	150 ohms	<2.2 dB per 100 meters	-52 dB
Coaxial	Thick Ethernet backbone cable	IEEE 802.3 10Base5	52 ohms	0.37 dB per 100 feet	N/A**
Coaxial	Thin Ethernet LAN	IEEE 802.3 10Base2	52 ohms	0.80 dB per 100 feet	N/A**
Coaxial	ARCnet LAN	ARCnet	93 ohms	<0.81 dB per 100 feet	N/A**

N/A*—Not applicable: This type of cable is not specified for network use
N/A**—Not applicable: This type of cable is not susceptible to crosstalk

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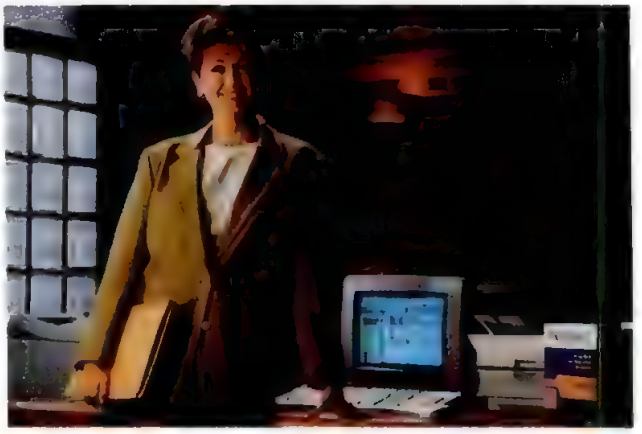

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▶ SUMMARY OF FEATURES

Cable Testers

PC MAGAZINE

Products listed in alphabetical order by company

■ = YES □ = NO

	John Fluke Manufacturing Co. Inc. **Fluke 650 LAN CableMeter**	Microtest Inc. **Microtest MT310 Scanner**	Microtest Inc. **Microtest MT350 Scanner**	Scope Communications Inc. **WireScope 16**	Wavetek Corp. **LANTech 10**
List price	$1,695	$1,495	$3,995	$1,495	$2,395
Can test for:					
Attenuation	■	■	■	■	■
Average noise	■	■	■	■	■
Cable length	■	■	■	■	■
UL grade level	□	□	■	□	□
Ethernet network traffic level	■	□	■	□	□
Best pair	□	□	■	□	□
Impedence	■	□	■	□	■
Impulse noise	■	□	□	□	■
NEXT	■	■	■	■	■
Opens	■	■	■	■	■
Pin-to-pin wire mapping	■	□	■	□	■
Resistance	□	□	■	□	■
Reversed pairs	■	■	■	■	■
Short circuits	■	■	■	■	■
Signal-to-crosstalk ratio	□	□	■	□	□
Cable testing:					
Number of prestored NVP values	12	None	80	None	18
User-definable NVP values	4	1	2	None	1
BNC/RJ-45 connectors	■■	□■	■■	□■	■■
LCD panel size (lines x characters)	4 x 16	2 x 16	2 x 16	2 x 16	4 x 16
Test selection interface	10-position rotary dial	3 buttons	18-key keypad	3 buttons	28-key keypad
Format of data uploaded to PC	ASCII report	Comma-separated	Comma-separated	Lotus 1-2-3	Comma-separated
Software required	Included	Included	Included	$300	$245
Dimensions (HWD, in inches)	1.7 x 4 x 7.6	1 x 4 x 7.5	1.8 x 4 x 7.5	1.5 x 4 x 7.5	1.5 x 4 x 8.3
Weight (pounds)	1.3	1	1.5	0.9	1.3
Batteries	Two 9-volt	One 9-volt	One nickel cadmium	One 9-volt	One nickel cadmium
Approximate continuous-use battery life (hours)	8	2	4	2	3

The RG numbering system is another popular cable-identification scheme. RG-58, for example, is Ethernet coaxial cable; RG-62 cable is commonly used in ARCnet installations.

Although the documentation for three of these cable testers (the Microtest MT310 Scanner, the Microtest MT350 Scanner, and Wavetek's LANTech 10) states that they can be used to certify cable within the various standards schemes, these units are all probably better used as troubleshooters.

GATHERING CABLE EVIDENCE

Before attaching the cable tester to your LAN, you must calibrate the unit for the type of cable installed. The cable tester will display incorrect results if it is not given correct information about the cable type, because it compares the tested results against the results expected for various cable types. Thus, the testing device must know the *nominal velocity of propagation* (NVP) for the cable before it can make accurate distance and performance determinations. Electricity travels at different speeds through different types of cable; NVP, expressed as a fraction or a percentage of the speed of light in a vacuum, thus is a distinctive indicator of that speed. The cable tester uses the NVP to gauge whether a cable is delivering as quickly as it should.

NVP can vary from 0.60 to 0.90. For example, Level 3 UTP cable has an NVP of 0.62, Level 5 UTP an NVP of 0.72, RG-58 an NVP of 0.80, RG-62 an NVP of 0.84, and Type 1 an NVP of 0.78. Even the difference between foam and non-foam insulation in the cable can change the results. Most cable testers come with a chart or table expressing the NVP values for popular cable types, but you should calibrate the tester anyway for the exact type of cable your LAN uses. Calibration is simply a matter of trying various NVP values on your cable until the cable tester displays the correct length for a cable whose length you are sure of.

Following calibration, the basic procedure for using a cable tester is simple. After you detach both ends of a piece of cable from the network, you connect the cable tester to one end and, for UTP cable, connect a loopback device to the other end. The genderless data connector usually found on STP cable is its own loopback device. Then you run through the tester's diagnostic steps.

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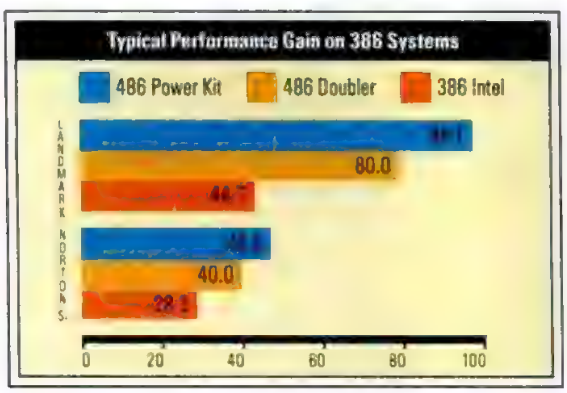

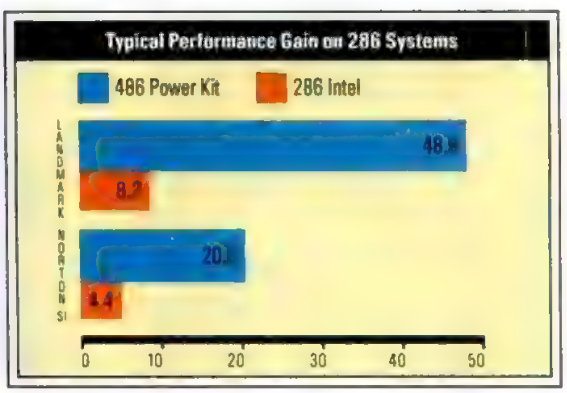

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CIRCLE 082 ON READER SERVICE CARD

The Future of Cable Testers

by Barry Nance

For some time, it has been that cable testers did just that: tested cable. Now manufacturers of cable testers are pushing the technology of cable analysis to greater heights. New devices from John Fluke Manufacturing Co. (the Fluke 670 LAN CableMeter) and Scope Communications (the FrameScope) extend cable testing beyond looking at the electrical characteristics of the cable; these devices now enter the domain of protocol analyzers, looking at OSI layers 2, 3, and even layer 4 somewhat. The Fluke 670 will run about $6,000 and the FrameScope about $4,000—each still quite a bit below the price of a standalone protocol analyzer, yet higher than many PC-based analyzers. (For more information, see "Low-Cost Analyzers: An Eye Into the LAN," *PC Magazine*, January 12, 1993.)

Each product comes in different models, one for Ethernet and one for Token-Ring setups. Both the Fluke 670 and the FrameScope accumulate and display statistics showing the health and performance of your network. In general, both of these testers display message-frame counts—either the total or the type of frame—in relation to elapsed time. For Ethernet LANs, the devices will reveal excess collisions (which indicate a jabbering network adapter), late collisions (if your cables are too long), and error-frame counts (which are the result of faulty connections).

On a Token-Ring LAN, each device can recognize and count media-access control (MAC) layer frames. These frames show neighbor relationships (in terms of MAU connections), receive congestion errors (network adapters whose buffers cannot handle incoming traffic), line errors, cyclic redundancy check (CRC) errors, and the dreaded beaconing LAN.

A Token-Ring adapter sends beacon frames downstream when the adapter stops receiving information from its upstream neighbor—perhaps the result of a cable problem. The two adapters—the beaconing one and its upstream neighbor—negotiate to see if one or the other should drop out of the ring and perhaps heal the wound automatically. When beacons are circulating around a ring, the other adapters stay silent, waiting for the ring to become healthy again.

Next-generation products will push the technology's envelope, blurring the line between cable testers and protocol analyzers.

Even when your LAN is beaconing, these new cable testers can insert onto the ring and determine the network addresses of the affected nodes. When an MAU port gets "stuck" because an MAU relay fails to open or close properly in response to signals from a network adapter, the tester will inform you of this condition and let you reset the port remotely from the enhanced cable tester. You can also determine if a Token-Ring cable is experiencing *phase jitter* (a difficult-to-sense noise condition that often indicates a bad MAU).

These devices do not decode and display particular LAN message frames. Instead, they take a snapshot of each frame as it goes by, determine the type and meaning of the frame, and increment appropriate counters in the cable tester's memory. Both of these units incorporate flash memory and have over 256K of RAM for frame buffers and statistics. You can choose to watch the overall network traffic, certain kinds of error situations, or traffic to and from a given node. You can determine which node is sending or receiving the most LAN traffic, or "ping" a file server or other LAN node to determine the active presence of that node. If you determine that a particular cable or network adapter is hurting the LAN, you can cause that network node to remove itself from the ring. You can monitor the status of bridges and routers. You can even determine token rotation time on a ring.

The manufacturers say that the units are designed to let you associate workstation names or people's names with network addresses, which makes it easy to see who is active on the network and whose connections are healthy. You won't have to somehow know that node 10005A123456 is Sue's PC. (Future versions of these and other cable testers will even be able to pick up node address and log-on account relationships automatically.)

The units have serial ports through which you can download upgrades into the flash memory chips. And, of course, they perform all of the more mundane cable tests that are the subject of this review.

These enhanced cable testers have sizable LCD screens and look even more—at first glance—like Game Boys than sophisticated network testing devices. Don't be fooled, though. The various categories of statistics they generate tell you enough about the character and volume of LAN traffic to solve problems, node by node. These new testers, like their predecessors, are important additions to any networking management armament. □

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Cable Testers

It's also a good idea to maintain an accurate diagram of your LAN's topology (layout). When a wiring fault is found, you will want to pinpoint the bad cable on the diagram so you can better understand how the symptoms of the problem relate to the wiring fault you've identified (for example, a particular group of workstations being dropped from the LAN).

When you've found that you need to replace a bad cable that is hidden in the floor or ceiling, attach the new cable to the bad one, and then pull the bad cable out. You'll automatically install the new cable in the process. Wire-pulling grease will make the job go even easier. Also, remember that your LAN is no stronger than its weakest link. Installing high-quality Level 5 UTP cable, in anticipation of someday running your LAN at 100 megabits per second, is a waste if your patch panel or punchdown block is an economy model that won't handle the high-speed signals. Don't undercut your wiring or workstations—not to mention your data—by not coordinating all the components in your network.

Always use a cable tester to check out a new LAN cable installation. Whether you are installing a whole new network or just a new cable segment to an existing LAN, it is important to verify that the new wires can carry noise-free LAN signals before users try logging onto a file server. If an independent contractor installs or maintains your LAN wiring, or does both, insist that the contractor perform all necessary cable tests during installation.

TOEING THE LINE

We put these cable testers through their paces with several kinds of UTP and coaxial cables. The cables were Level 3, 4, and 5 UTP, thicknet, RG-58, RG-58 foam, RG-59, RG-59 foam, and RG-62 wire. We used a Fluke LAN Media Demonstrator to create shorts, opens, reversed pairs, and crosstalk cable problems. In addition, we deliberately spliced RG-58 and RG-62 coaxial cable (a somewhat common wiring error) to test whether the devices could detect mismatched impedances. We used a tape measure to determine the actual length of various cables, and then evaluated how well each cable tester electrically measured each of these cables. The products' documentation and ease of use were also important considerations. We noted each product's upgradability, battery life, and ability to print results or upload results to a PC. The variety of cable types the product was able to test was a key criterion.

John Fluke Manufacturing Co. Inc.

Fluke 650 LAN CableMeter

BY BARRY NANCE

The Fluke 650 LAN CableMeter is an approachable, versatile cable tester with an excellent interface. Its ten-position rotary-dial switch gives access to a full range of cable-testing functions. The autotest dial position checks for opens, shorts, NEXT, impedance, and proper termination. Other dial positions determine a cable's wire map and length, configure the unit for up to four custom

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cable types (the unit comes with default NVP settings for 12 standard cable types), calibrate for the correct NVP, perform self-test diagnostics, print to a serial printer, measure Ethernet network traffic levels, and test for noise. The four push buttons let you power the unit on and off, select the cable type to be tested, and choose actions for saving results.

SUITABILITY TO TASK

Fluke 650 LAN CableMeter

	POOR	FAIR	GOOD	EXCELLENT
Ease of use	●	●	●	●
Versatility	●	●	●	○
Testing features	●	●	●	○

The 4-line by 16-character LCD panel shows both the menu options and test results. You can test various cable types: 10BaseT UTP (Level 3, 4, or 5), IBM Type 3 (Level 3, 4, or 5), 10Base2 thinnet, RG-58 (foam- and non-foam–insulated), RG-59, RG-62, and custom cables. The Fluke 650 has BNC and RJ-45 connectors for coaxial cable and UTP testing, but no adapter option for STP cable.

The user manual is clear and straightforward, and includes a discussion of the criteria that make up a quality LAN cable. It also covers print options for the 650, which allows you to store as many as 50 cable test reports at remote sites for later printing. The manual describes how to print either a single traffic report or stored cable test reports to a printer hooked up to the serial port, but it doesn't mention that with a little creativity you can also upload the reports to a PC for storage and manipulation.

In addition to its many testing capabilities, the Fluke 650 reports on Ethernet traffic statistics, including average and peak network utilization, the collision rate, and the presence of a jabbering network adapter. The unit requires three nonrechargeable 9-volt batteries to operate; two go into the tester and one fits inside the loopback unit. It can test cables for at least eight hours or more of continuous usage.

PC EDITORS' CHOICE

FACT FILE

Fluke 650 LAN CableMeter

John Fluke Manufacturing Co. Inc., P.O. Box 9090, Everett, WA 98206-9090; 800-443-5853, 206-347-6100; fax, 206-356-5116

List price: $1,695

In short: The Fluke 650 LAN CableMeter is an easy-to-use, accurate cable tester that held up well during our tests. It has an approachable ten-position rotary dial, can report on Ethernet traffic levels, and automatically resets when it detects a new cable. Also, its documentation is better than average

483 ON READER SERVICE CARD

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CIRCLE 116 ON READER SERVICE CARD

Microtest Inc.

MT310 Scanner
MT350 Scanner

The MT350 Scanner and MT310 Scanner are two notably different cable testers from Microtest, but each certainly carries advantages of its own. The MT350 is a remarkably versatile cable-testing device, with a database of more than 80 cable types and a user manual that was the clearest and most thorough of all the units we reviewed. The database even includes specifications for multimedia twisted-pair and permits one custom coaxial and one custom twisted-pair set of NVP values.

The MT350 has an 18-key keypad for selecting cable types and tests. The auto-test mode reports pass or fail and lets you scroll through results from several tests: noise, cable length, resistance, attenuation, impedance, NEXT, signal-to-crosstalk ratio, wire map, find best pair, and determine UL cable grade. Other keys function to calibrate the NVP, print reports, monitor network traffic levels, run self-test diagnostics, and perform setup functions. In addition, you'll note that each key performs triple duty, depending on the function-key combination you hit. For example, the number 5 key can deliver the specification for Token-Ring 16, or it can initiate printing.

SUITABILITY TO TASK

Microtest MT310 Scanner

	POOR	FAIR	GOOD	EXCELLENT
Ease of use	●	●	●	○
Versatility	●	●	○	○
Testing features	●	●	○	○

SUITABILITY TO TASK

Microtest MT350 Scanner

	POOR	FAIR	GOOD	EXCELLENT
Ease of use	●	●	●	○
Versatility	●	●	●	●
Testing features	●	●	●	●

The 2-line by 16-character LCD screen prompts for responses and displays test results. Optional additional equipment from Microtest lets you trace wires, locate an office in which a cable terminates, and perform specialized Token-Ring tests. The MT350 comes standard with BNC and RJ-45 connectors. It will display a rudimentary graph of network utilization on the LCD panel, and print a report of up to 24 hours' worth of utilization.

The MT350 can send the results of testing for as many as 50 cables to a serially connected printer. You can upload results to a PC by using a modem cable and communications software. The data transfers to the PC as a collection of comma-separated value (CSV) records, with each record containing a maximum of 111 data fields. You can input the results directly into a database manager or a spreadsheet program. The same PC-to-tester serial link gives you the option of

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FACT FILE

MT310 Scanner

MT350 Scanner

Microtest Inc., 4747 N. 22nd St., Phoenix, AZ 85016; 800-526-9675, 602-952-6400; fax, 602-952-6660

List price: MT310, $1,495; MT350, $3,995.

In short: The MT350 Scanner is a good choice for those who deal with many LANs at many sites, and the MT310 Scanner is aimed at the network manager whose LAN is wired with UTP cable

484 ON READER SERVICE CARD

downloading upgrades into the MT350's flash memory.

The MT350's hard-shell carrying case is about the size of a small briefcase. The cable tester itself is encased in hard rubber and is definitely designed for travel and rugged use. The rechargeable nickel cadmium battery is replaceable, and it lasts for about 4 hours of continuous use after a night's recharging.

The MT310 is one of the MT350's little brothers (Microtest makes several cable testers). Not nearly as full-featured as the MT350, the MT310 is still a good cable tester, with a similar 2-line by 16-character screen, but simpler options. It checks either a coaxial or UTP cable for basic faults, detecting and displaying data on opens, shorts, reversed pairs, NEXT, attenuation, noise, and the cable length. With optional equipment from Microtest, the MT310 will trace the cables in your office.

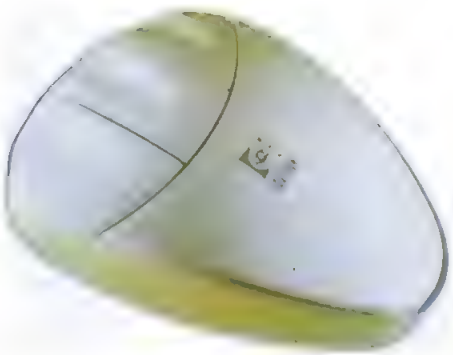
The UTP cable connects directly to the MT310's RJ-45 port, or you can use the supplied UTP-to-coaxial adapter. The MT310 tests only 10BaseT or Token-Ring UTP wires; it does not test 10Base2 coaxial networks, nor does it include a database of NVP values for popular cable types. You can either set the NVP value by using the simple three-button keypad, or you can have the MT310 calculate the NVP for a known length of cable.

The MT310 has a printer port and can output results in report or CSV form to a PC. The MT310's memory will save the results of one test report. The 9-volt alkaline battery it requires will need replacing after about 2 hours of continuous use.

Scope Communications Inc.

WireScope 16

The WireScope 16 is a simple device with a single purpose: the testing of UTP cables. Using its three-button keypad (on/off, select, and enter), you choose between Token-Ring and Ethernet cable, set your cable test data rate to 10 or 16 megabits per second, scroll to the NVP value for the cable you're testing, and



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CIRCLE 182 ON READER SERVICE CARD

then run the tests. The unit will check a cable's continuity (for opens, shorts, and reversed pairs), NEXT, attenuation, noise, and cable length. It also tests lobe insertion for Token-Ring cables. If multiple error conditions are present, repeatedly pressing the select button will show them on the display. The device also distinguishes between active and passive multistation access units (MAUs, for Token-Ring wire) and hubs (when it comes to Ethernet cable) in its calculation of signal-to-noise ratio. If you don't know the NVP value for the type of cable you need to test, you can use the calibration mode on a cable of known length to determine this value.

SUITABILITY TO TASK

WireScope 16

	POOR	FAIR	GOOD	EXCELLENT
Ease of use	●	●	●	○
Versatility	●	●	●	○
Testing features	●	●	●	○

WireScope 16 lets you test Token-Ring (IEEE 802.5) or Ethernet (IEEE 802.3) cable through two RJ-45 ports. Port A is for standard UTP Token-Ring wire; port B is for either nonstandard Token-Ring (using the same wire pairs as Ethernet wire) or standard UTP Ethernet cable. An optional adapter enables the unit to test STP cables such as IBM Type 1.

The unit has a printer port for producing reports on a portable thermal printer, and Scope Communications sells an RS-232 serial cable for attachment; however, the printer must be purchased separately from a printer vendor. Scope Communications' optional Cable Profile Data Logger lets you upload the test results to a PC.

The 2-line by 16-character LCD screen scrolls through each of the test results one at a time when you press the Select button. The WireScope has no port for an AC adapter; you must use a replaceable 9-volt alkaline battery, which will last for about 2 hours of continuous usage.

FACT FILE

WireScope 16

Scope Communications Inc., 100 Otis St., Northboro, MA 01532; 508-393-1236; fax, 508-393-2213

List price: $1,495.

In short: The WireScope 16 is a good choice for the LAN administrator who wants to keep cable testing very simple. It has only three buttons, one of which turns the unit on and off. It tests only UTP wiring on Token-Ring or Ethernet LANs, and it receives its power from a battery, since it has no port for an AC adapter.

485 ON READER SERVICE CARD

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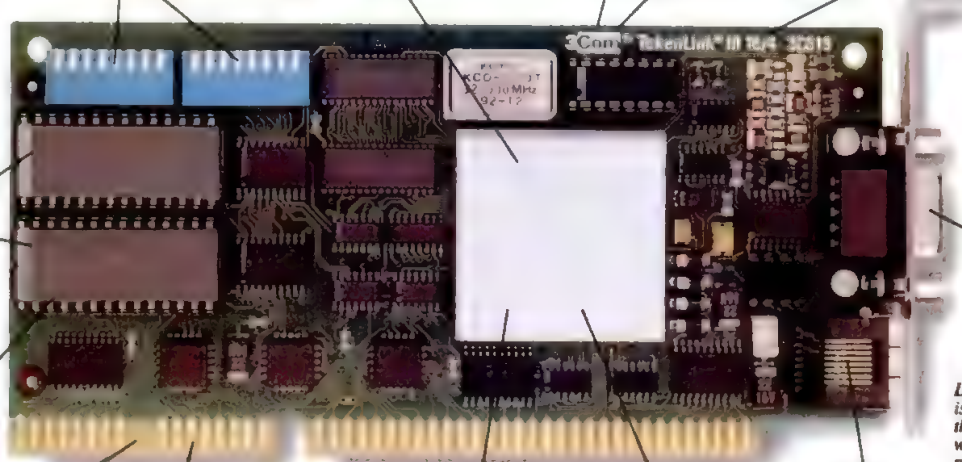

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Wavetek Corp.

LANTech 10

The LANTech 10 is versatile in terms of the number of cables it can test and the tests it offers. Its keyboard, however, is the most complicated of the bunch, with 28 Chiclet-style keys for performing eight tests on LAN cables—and its manual does not have an index.

The LANTech 10 checks a cable's wire map, resistance, length, capacitance, attenuation, NEXT, impulse noise, and average noise. Except for the cable length, this device displays most results as pass, fail, or over. The unit determines whether a cable is healthy based on prestored thresholds for the cable type selected. The LANTech 10 tests many different types of cable: Ethernet, Token-Ring, twisted-pair, miscellaneous, or custom. This tester stores each cable's pin-out value, NVP, maximum length, maximum capacitance, maximum loop resistance, the pass/fail results for attenuation and NEXT, frequency range, and attenuation/crosstalk limits.

In addition, it can monitor utilization on Token-Ring, Ethernet, or ARCnet LANs, displaying the utilization as a percentage of network capacity on the 4-line by 16-character screen. It also features a self-test diagnostic.

The LANTech 10 has built-in BNC and RJ-45 connectors, and Wavetek offers an optional connector for STP (Type 1) cable. A portable printer and DOS-based cable database software are available as options. This tester runs off a nonreplaceable nickel cadmium battery that lasts about 3 hours during continuous use and recharges in about 14 hours; it can also obtain power via the included AC adapter. □

SUITABILITY TO TASK

LANTech 10

	POOR	FAIR	GOOD	EXCELLENT
Ease of use	●	●	●	○
Versatility	●	●	●	○
Testing features	●	●	●	○

FACT FILE

LANTech 10

Wavetek Corp., 9145 Balboa Ave., San Diego, CA 92123; 800-854-2708, 619-279-2200; fax, 619-450-0325

List price: $2,395.

In short: The LANTech 10 is versatile, with prestored thresholds for 18 cable types that include two user-definable types. The 28-key keyboard is a bit much for such a small device, though. Its power source can be either a rechargeable nickel cadmium battery or AC (via an adapter). It can monitor network traffic

486 ON READER SERVICE CARD

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PC MAGAZINE

Network Edition

THE LATEST NETWORK PRODUCTS AND MANAGEMENT TECHNIQUES

Across the Network Management Gap

A new specification will make managing networked PCs a lot easier, if buyers can avoid some hidden pitfalls.

By Barry Nance

FOR MOST NETWORK MANAGERS, THE PC remains a tantalizing but unreachable source of crucial information that would help solve many networking problems. Without this information, the network data gathered from a sundry of devices—bridges, routers, UPSs (uninterruptible power supplies), and wiring hubs, to name a few—remains decidedly incomplete.

Proprietary methods are available for managing the desktop, but no proprietary method adequately integrates desktop information with data collected from other network devices. Without the ability to correlate information from all network devices, a manager's view of the network is imperfect at best.

An emerging management specification just might offer a solution. Dubbed the Desktop Management Interface (DMI), the specification aims at creating a standard management agent that can gather from any DOS-based PC.

At a minimum, DMI will identify the manufacturer, name, version, serial number (if appropriate), and installation date and time of a component. More extensive implementations will extend these entries and provide a host of information such as the amount of memory installed and problems with the device.

With this information, network managers can be smarter about the way they troubleshoot and maintain PC-centric LANs. By combining this information with data gathered from bridges, routers, and wiring hubs, network managers can for the first time begin to diagnose enterprise-wide problems

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without leaving their desks. They will, for example, be able to determine why two users on separate networks can't communicate.

Perhaps what's most impressive, though, about DMI is its source: the Desktop Management Task Force (DMTF). Headed by Digital Equipment Corp., IBM, Intel, Microsoft, Novell, Sun Microsystems, SynOptics Communications, and nearly 200 other vendors, this consortium may just have the clout to turn DMI into an industry standard.

The current draft of DMI (released in March) defines a management agent for DOS and DOS/Windows workstations. Drafts for Macintosh, OS/2, Unix, and other environments will follow. The final specification is expected later this year.

The potential benefits are enormous but not without cost. Though managers won't have to pay to gain DMI functionality, they will need to upgrade their existing clients, which will be a substantial investment. What's more, buyers must be careful about the level of DMI support they purchase. Some DMI implementations will gather more data than others.

Vendors will also find that even proficient assembler programmers may have difficulty writing the code necessary for building the agent. This could further delay DMI's acceptance, though with DMI's potential benefits, most vendors expect to support DMI by year's end.

Yet Another Standard

The efforts of the Desktop Management Task Force (DMTF) aren't the first in the area of network management. Lots of vendors offer products that work with SNMP (Simple Network Management Protocol).

SNMP comes from the group involved with developing and enhancing the TCP/IP protocol suite: the Internet Engineering Task Force (IETF). SNMP uses a database, or Management Information Base (MIB), to identify manageable components as well as the actions they support. Standard MIB formats, such as MIB II and Host Resource MIB, let you manage a variety of end-station objects, such as the programs running in a computer the time the machine was last booted.

But the specification doesn't allow vendors to build a compact management agent to perform component-level actions (resetting a network adapter, for instance). Such an agent would rarely be smaller than 20K and even then would require product-specific extensions.

The resulting proprietary nature of MIBs and the difficulty of integrating the MIBs into your network management software pose significant hassles for network managers.

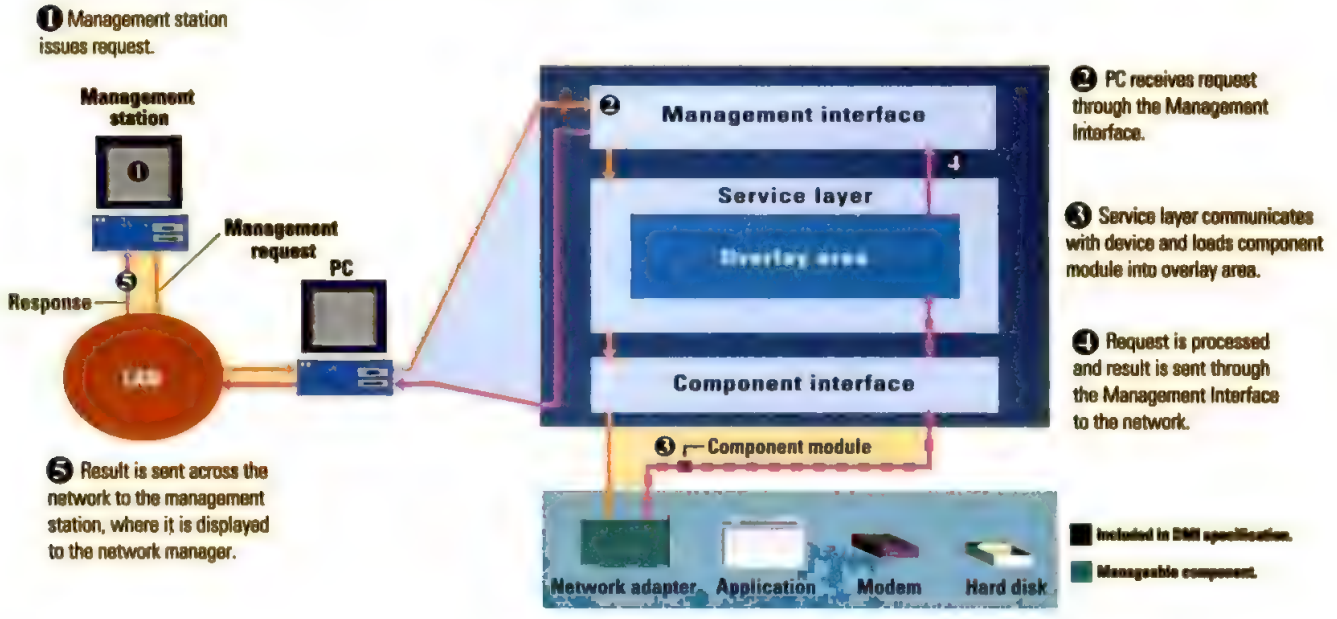
NETWORK MANAGEMENT TODAY

The DMTF's efforts aren't the first in the area of network management. Currently, a number of proprietary schemes and two standards—the widely supported Simple Network Management Protocol (SNMP) and the less popular Common Management Information Protocol (CMIP)—define ways of gathering information from networking devices.

SNMP and CMIP define three components: an *agent*, a *console*, and a *protocol*.

Getting Information from the DMI Agent

Management stations go through five steps in processing and answering management requests.



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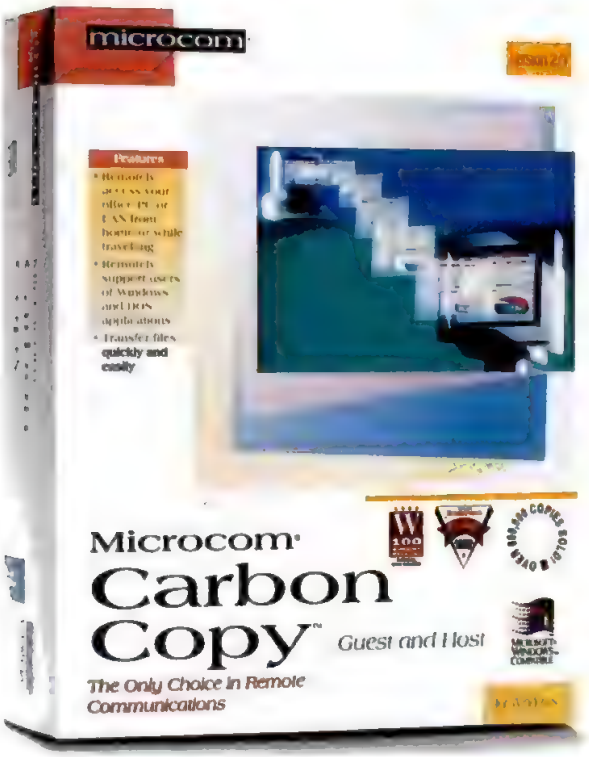

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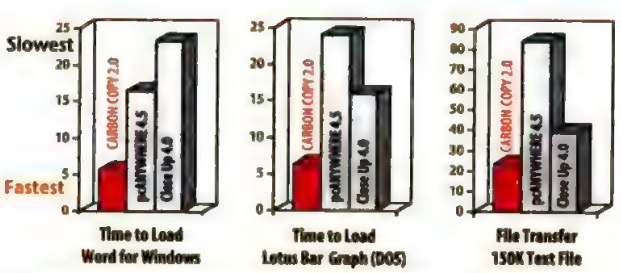

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The agent is code developed by the vendor that resides in a particular device. It gathers network information from the product and stores that data in a database. The format for this database, called the Management Information Base (MIB) in SNMP parlance, is specified by the SNMP specification.

The console is where network managers request and display information from the agent. Connecting the console and the agent is the protocol, or the language for requesting networking information from and returning it back to the console.

Although SNMP and CMIP let network managers gather information across the enterprise from a range of devices, neither have been sufficiently implemented at the desktop. That's partly because they consume too much space.

Proprietary tools are available for managing the desktop. Brightwork Development, Frye Computer Systems, Intel Corp., Microcom, Norton-Lambert Corp., and Triton Technologies are just some of the vendors to offer packages that perform any number of tasks ranging from cataloging the software and hardware of the PC to allowing network managers remote control of the PC.

These tools, however, lack the broad acceptance that SNMP and, to a lesser extent, CMIP enjoy. Without that acceptance, software developers have the impossible task of developing a separate agent for every device on the network. More often than not, network managers end up with a slew of tools for managing all aspects of their networks.

Understanding MIF

The Management Information Format (MIF) definition begins with general information common to all components including name and description. The location for component's management module (the overlay) is provided in a second section. The remaining part of the MIF component enumerates one or more attributes for that component. These attributes are contained in groups.

◯ General Information ◯ Overlay Module Location ◉ Attributes

```
; Prototype DMI compliant MIF fragment
; for the imaginary ACS-100 computer
; (lines beginning with a semicolon are comments)

START COMPONENT
NAME="ACS Computer, model 100"
FUNCTIONLIST={"ACS|SystemGroup|x001"}
DESCRIPTION="Base ACS 100 System"

    START PATHS "DOS"
    ACSCOM=C:\MIF\ACS.COM
    END PATHS

        START GROUP
        NAME="ComponentID"
        ID=1
        CLASS="DMTF|ComponentID|1.0"
        DESCRIPTION="Required. Common to all components"
        START ATTRIB
        NAME="Installation"
        ID=5
        ACCESS=READ-ONLY
        TYPE=STRING(32)
        DESCRIPTION="Time/date PC put into service"
        VALUE="7/4/93"
        END ATTRIB
        END GROUP
        END COMPONENT]]
```

THE DMI SOLUTION

DMI hopes to change that. Like SNMP and CMIP, DMI presupposes three elements: an *agent* collecting network management information inside the user's PC, a *management console* where the data is displayed and requests are issued, and a *communications protocol* that allows the management station to query the agent.

Unlike SNMP and CMIP, however, DMI only defines the architecture of the agent. And, different from SNMP or CMIP agents, the DMI agent consists of a main component, a TSR, and overlays. The main component resides permanently in memory and consumes about 6K. Overlays are individual modules that are called by the main agent for managing the different components in the PC. These components may be hardware (such as a hard disk) or even software (such as a specific application). When a LAN administrator issues a DMI command, the main agent in the PC automatically loads the overlay for the specific component.

Although software, hardware, and other elements of a PC are important, network adapters remain the prime candidates for LAN management software. This is primarily because most client problem-solving begins with determining whether the PC is connected to the LAN. With DMI, LAN administrators will be able to query the general health of all network adapters on the LAN, as well as query their traffic statistics.

There are three portions of a main agent. First are the files storing information about each component. The specification for the way in which this information is formatted is called the

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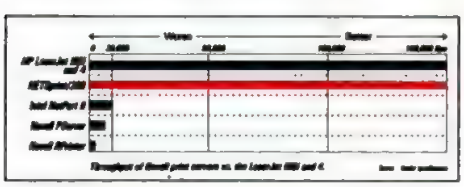

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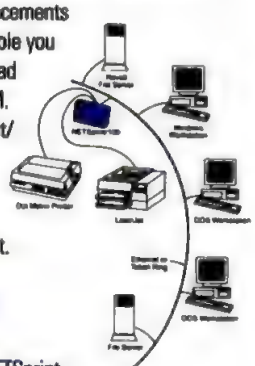

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NETSprint 100+	Ethernet 10Base-T and BNC Thinnet 4/16MB Token Ring DB9 and RJ45	Novell NetWare	2 parallel 1 RJ45 Unport	512K ROM 512K RAM	$1,095 (E) $1,095 (T)
NETSprint 200	Ethernet 10Base-T and BNC Thinnet 4/16MB Token Ring DB9 and RJ45	Multiple Novell Apple	2 parallel 1 RJ45 Unport	512K Flash ROM 2M RAM	$1,495 (E) $1,495 (T)
JETPrint 100	Ethernet 10Base-T and BNC Thinnet 4/16MB Token Ring DB9 and RJ45	Novell NetWare	1 MIO interface	512K ROM 512K RAM	$995 (E) $995 (T)
JETPrint 200	Ethernet 10Base-T and BNC Thinnet 4/16MB Token Ring DB9 and RJ45	Multiple Novell Apple	1 MIO interface 1 RJ45 Unport	512K Flash ROM 2M RAM	$1,595 (E) $1,595 (T)

*available Q2/93 TCP/IP protocol Q2/93 SNA

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Management Information Format (MIF). This is roughly equivalent to SNMP's MIB definition. Below the MIF files is the second component, the Component Interface (CI), which defines how the main agent can issue commands to query, reset, or control components. And above the MIF files is the Management Interface (MI), which lets a LAN product vendor query, control access, and be notified when a threshold is exceeded (this is called an *Event Notification* in DMI parlance and an *Alert* in SNMP lingo).

A management console can use three commands to query an agent: List, Get, and Set. A management application will use one or more of the List commands to query a PC's MIF files to determine what components are installed in that machine. Other List commands let the management application discover the functions of a particular component. Get allows the management station to request individual statistics from a component, and Set allows the management station to alter that statistic.

While DMI deals with MIF files and component-management commands in great detail, it doesn't specify how the information and the commands cross the LAN. Information and commands will cross the LAN in any number of ways: via SNMP or CMIP, or even by writing directly to a network layer protocol such as IP or NetWare's IPX. Many users will want some kind of mapping between SNMP and DMI so they can query DMI agents with their existing SNMP-based management stations. This will then allow network managers to integrate data collected from the PC with data collected from other network devices. To date, this layer has not been defined, though it is expected to be completed by year's end.

Building In Better Management

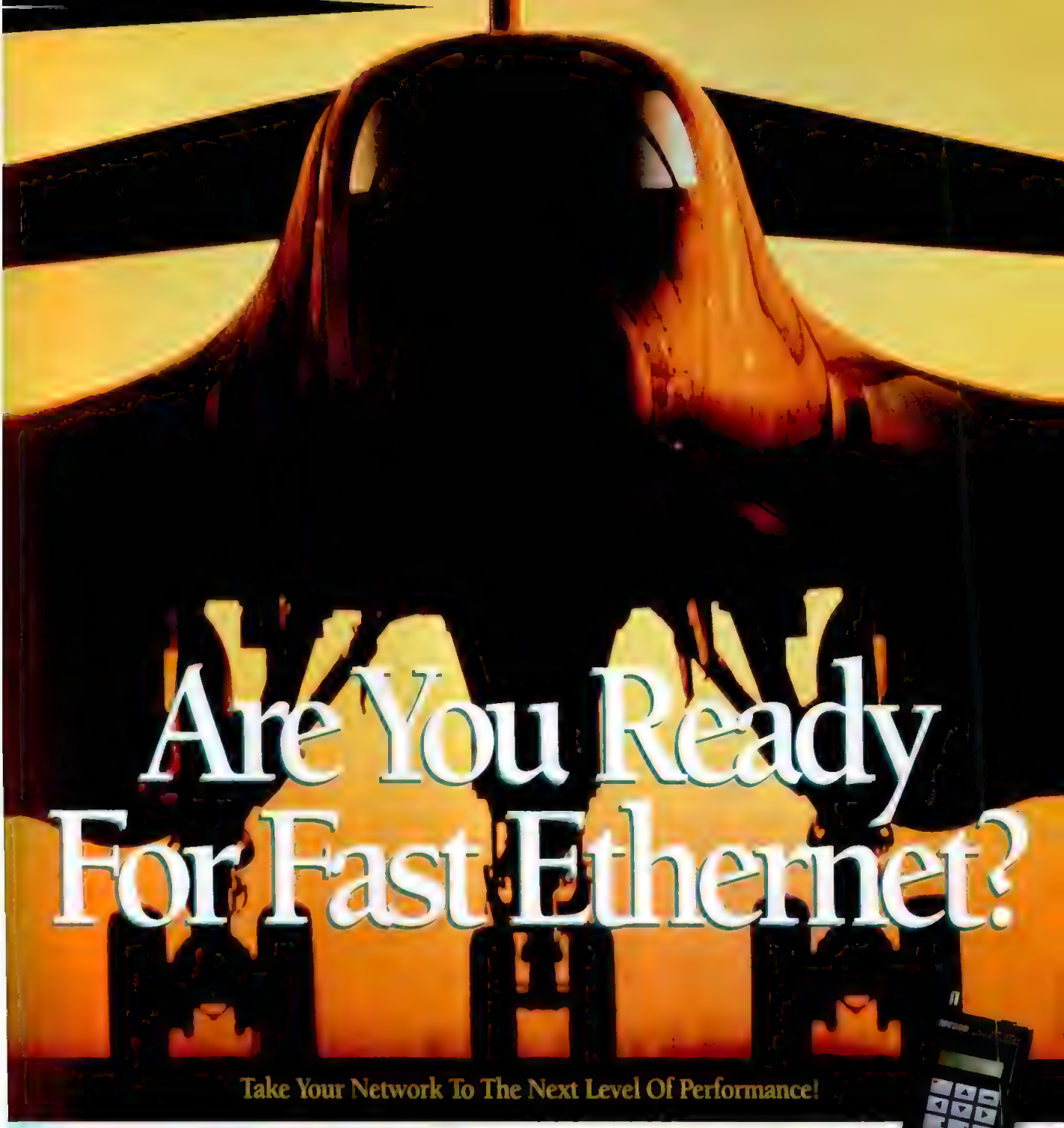
Many vendors are developing DMI-compliant products. Some are expected to ship by year's end; others should become available early next year.

Company	Product	Type
Asante Technologies Inc. (408-435-8388)	EtherPac series, MACCON series, MacRing series, TokenPac series	Network adapters
Digital Equipment Corp. (603-884-5111)	PolyCenter	Network management platform
Hewlett-Packard Co. (408-720-2300)	Vectra PC series	PCs
	OpenView for Windows	Network management platform
IBM Corp. (Call your local representative)	OS/2	Operating system
	LAN Network Manager	Network management platform
Intel Corp. (800-538-3373)	EtherExpress, TokenExpress	Network adapters
	SatisFaxion	Fax modem
	StorageExpress	LAN backup
	NetPort	Print server
	LANDesk	Network management platform
Microcom Inc. (617-551-1000)	LANLord	Network management platform
Microsoft Corp. (206-882-8080)	Windows, Windows NT	Operating systems
	Hermes	Network management platform
NCR Corp. (619-578-9000)	Star Sentry Client Manager	Network management platform
NetLabs Inc. (415-961-9500)	NetLabs Manager	Network management platform
Novell Inc. (408-434-2300)	NMS	Network management platform
Saber Software Corp. (214-361-8088)	Saber LAA	Network management platform
SMC Corp. (516-435-6255)	EliteSeries	Network adapters
Spry Corp. (206-447-0300)	AIR for Windows, AIRMAIL,	LAN utilities
	AIRSOL, RPC for WINSOCK	
SunConnect (415-960-1300)	SunNet Manager	Network management platform
SynOptics Communications Inc. (408-988-2400)	LattisCell ATM	Switch
	LattisHub	Wiring hub
	Optivity	Network management platform
3Com Corp. (408-764-5000)	EtherLink series, TokenLink	Network adapters
	ISOVIEW, ViewBuilder	Network management platforms
	ISOLAN	Bridge
	NetBuilder	Router
	LinkBuilder	Wiring hub

THE DRAWBACKS OF DMI

As you'd expect, LAN management software will need additional RAM over and above the 6K used by the TSR in order to send and receive management requests and responses. Even then, frugal designers and skilled assembler programmers will be needed to keep the size of the MIF transport software to a minimum.

Even a skilled assembler programmer, though, will find the TSR overlay management scheme a tricky environment in which to implement the processing of MIF language commands, although the DMTF will supply program templates and sample source code. DMTF's TSR specification may present problems. The TSR, for example, will have to serialize access to the program's overlay area, which is where the agent loads and unloads modules for managing individual components. This is important to prevent two requests for component module information from colliding with each other. Programmers aren't perfect and neither are the software modules they write. After LAN vendors iron out the



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initial wrinkles and fine-tune their DMI software, however, you'll most likely find DMI-aware LAN products the rule rather than the exception in most organizations.

What's more, not all the information in the MIF files will be generated completely by the computer. And the amount of work it will take for you to enter manually the reams of information about your networked PCs is daunting, to say the least. LAN vendors will be able to supply component-specific MIF-file data when you buy new products, but you'll have to upgrade the PCs, network adapters, hard disks, and other components your company already owns. Moreover, you'll need to design and implement a plan for gathering and entering MIF data if you want to take full advantage of DMI. A remote-control text editor would be helpful, but such a product has not been defined by the specification.

The success of the DMTF's efforts will depend on two factors. Suppliers of LAN products will need to update LAN drivers and perhaps redesign hardware so that they are DMI-aware. LAN management software vendors will need to add MIF language processing to their products.

Both criteria will be met if the DMTF vendors support the specification. But even non-DMTF vendors are excited about DMI. "There's just no meat in SNMP for managing desktop computers," says David Kaufmann, president of DeskTalk Systems, a manufacturer of a LAN management system that currently relies on SNMP agents to gather data on networked PCs. Kaufmann thinks DMI is most likely the wave of the future.

THE FUTURE OF DMI

Walt Thirion, president of Thomas-Conrad Corp., a maker of network adapters, agrees. Thirion says that DMI fills a large, gaping hole in network management: the administration and control of PC workstations. Thirion believes that all LAN vendors will eventually have to support DMI if they expect to sell hardware and software to companies with PC-based LANs.

With those sentiments and the backing of the leading networking vendors, DMI will almost certainly catch on as a standard. A better alternative doesn't exist.

In order for DMI to succeed fully, however, NT, OS/2, Unix, and Windows clients must be supported. With these environments, as with DOS, expect to find the DMI TSR functions included in the operating system.

Not every device and component will be instantly DMI-compliant and DMI-aware, of course. At first, your PC will load the DMTF-supplied TSR and only a single component module, perhaps one for the PC itself. Later, you'll install a new driver for your network adapter that is DMI-compliant. Eventually, if DMI catches on, you'll have component modules that DMI management stations can use to gather information on every device in your PC. When that day arrives, your LAN administrator will spend less time walking around the office and more time actually solving problems.

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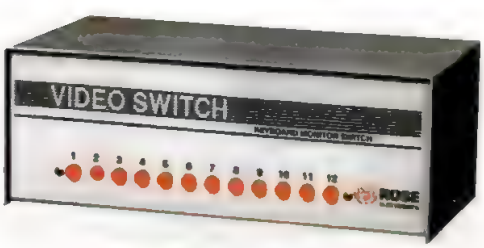

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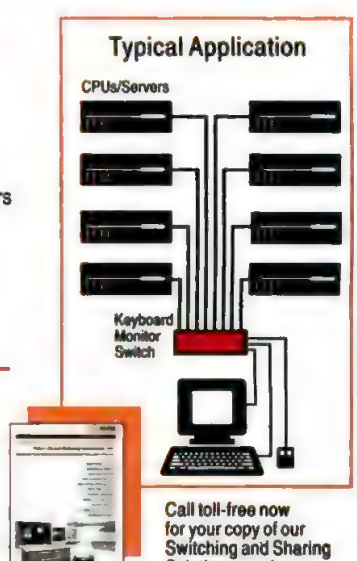

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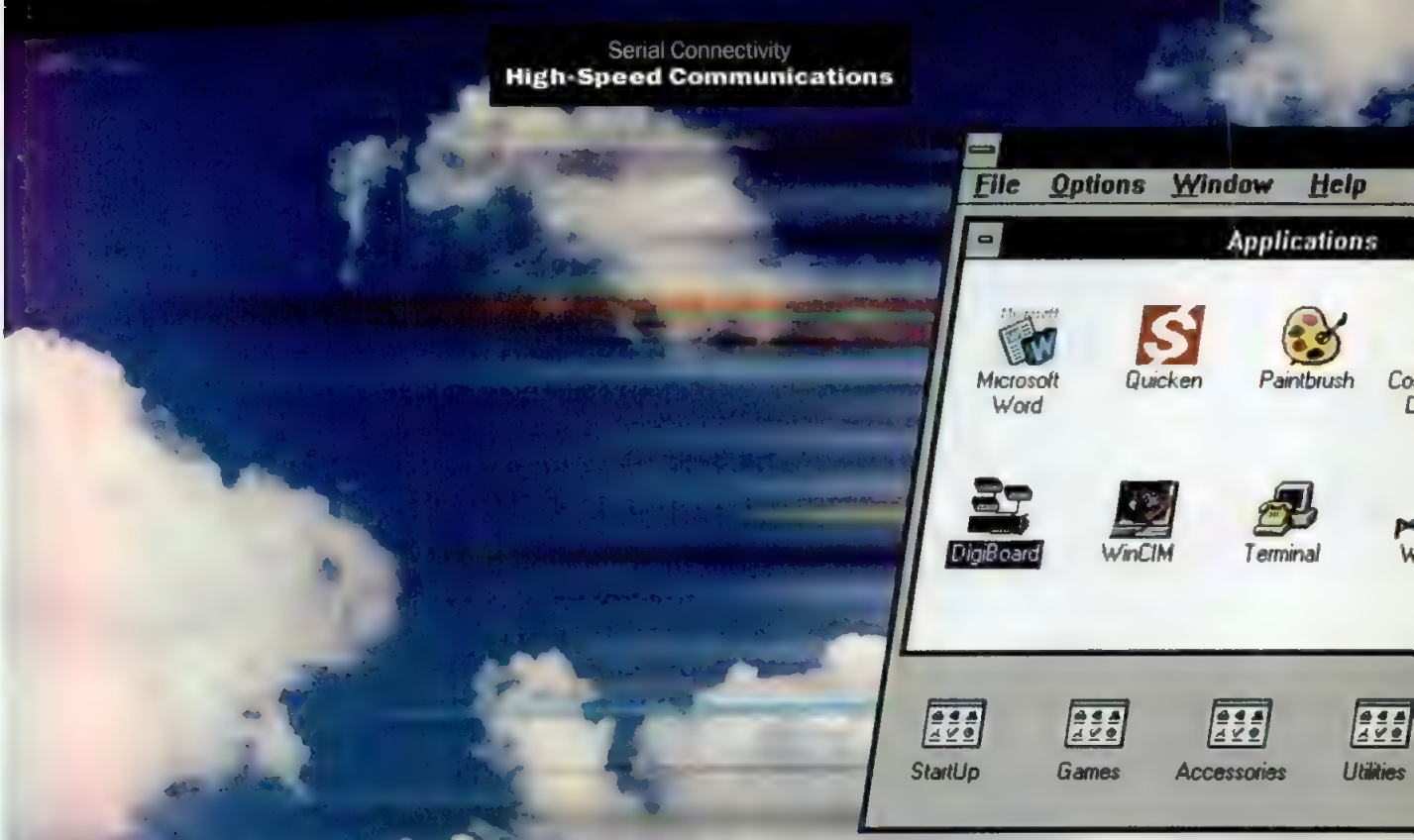

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*PC Week, July 1992. Lab test of a 386-based PC running Windows 3.1.

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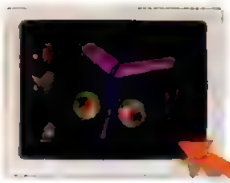


If it runs on the host, it runs in a Proxy window. Even graphical DOS programs.

Take The Plunge With Proxy. It's Network Remote Control For Windows, From Windows.

Some things you expect in remote control software. Like lightning-fast speed. And control over both DOS and Windows on the host PC. But new Proxy gives you something you probably don't expect. Because it not only works with Windows, it works from Windows. And that makes all the difference.

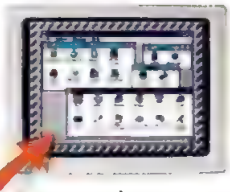
You see, other remote control products run from DOS, even those that support a host running Windows. So they allow just one connection at a time, and demand total attention from your computer. But Proxy is a Windows application that lets you make multiple connections simultaneously. You can display and control a different host PC in each window you open, while you continue to run local applications.

You can connect to multiple PCs over a network, with each appearing in its own window.

Users Calling For Help? Leap Out The Nearest Window.

If your job is to help users on the network, Proxy will make it easier.

Run time-consuming jobs on dedicated processors, and control them all from Proxy.



Proxy supports host computers running Windows.

No need to abandon your own work when someone calls. Just click on a Proxy icon and instantly connect to the caller's machine. You now have full control of their hardware and software, complete with mouse and keyboard support, whether they're running Windows or DOS.

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CIRCLE 870 ON READER SERVICE CARD

System Requirements: Proxy "Master" runs in Windows and can control multiple "Hosts" running DOS or Windows over an IPX network (e.g. NetWare).

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Mapping the Cable Mess

Cabling may be ugly, but it's crucial to building a network. Here's a look at the cabling standards and what they mean.

by Frank J. Derfler, Jr.

THE VALUE AND WONDER OF TODAY'S networks is that products from many different companies all work together. LAN adapters from 3Com and Standard Microsystems, for example, can communicate with each other across a cable because the designers of both adapters followed the same networking and communications standards. Ideally, cabling designers would follow suit. But the array of specifications that cover cables has grown from many sources and ranges from fire codes to detailed electrical specifications. As a result, these cabling and wiring plant specifications and standards are often overlapping and confusing, yet understanding them is crucial to designing a successful networking and cabling scheme. The cabling system is probably the most expensive (and certainly the longest lasting) part of any network. And the network can't be any better than the quality of its cabling.

Unfortunately, there's a long list of organizations, government bodies, and companies that regulate and specify the kinds of cables that you use. National and international organizations such as the Institute of Electrical and Electronic Engineers (IEEE), the Electronic Industry Association and the newer Telecommunications Industries Association (EIA/TIA), and Underwriters Laboratories (UL), along with numerous other government agencies at various levels that develop fire and building codes, all issue specifications for cable material and installation.

The EIA/TIA has issued EIA/TIA 568 and 569 standards for the electrical characteristics of LAN cables and has an active program to expand the types of technology that are covered by those standards. The Institute of Electrical and Electronic Engineers includes minimal cable requirements for Ethernet and Token-Ring systems in its 802.3 and 802.5 specifications, but some of the IEEE's work is now being overshadowed by the popularity of the unshielded twisted-pair (UTP) wire specified by the EIA/TIA and UL. The National Fire Protection Association (NFPA) established the National Electrical Code of the United States (NEC), which describes various types of cables and materials that should be used in the cable. The Underwriters Laboratory focuses on safety standards and has expanded its certification program to evaluate shielded and UTP LAN cables for the characteristics defined by the IBM, EIA/TIA, and NEC safety specifications.

EVALUATING THE PDS

Some companies, such as AT&T, Digital Equipment Corp., Hewlett-Packard, IBM, and Northern Telecom have developed volumes of detailed specifications that specify the connectors, wiring, distribution centers, and installation techniques called premise distribution systems (PDSs). (See illustration.) These vendor PDS architectures preceded and inspired the EIA/TIA and UL work, so they largely conform to the newer standards.

AT&T calls its architecture the AT&T Systimax Premises Distribution System, Digital uses the name Open DECconnect, IBM calls its architecture simply the IBM Cabling System, and Northern Telecom has the Integrated Building Distribution Network (IBDN). IBM and AT&T fielded their systems in 1984 and 1985, and DECconnect came out in 1986. Northern Telecom's IBDN, which is quite similar to AT&T's Systimax, is a relative newcomer that emerged in 1991.

Overall, the plans from IBM and AT&T have had the most profound effect on the industry; cables in catalogs are often rated in terms of IBM or AT&T specifications. Other companies, particularly Amp, Anixter, and Mod-Tap market and sell specific equipment for structured wiring systems, which encompass wire to the desktop and between floors. Anixter stands out for setting openly documented and fair performance and electrical standards for twisted-pair wiring. Anixter's original concept of levels (cabling types) is used by EIA/TIA and UL in their standards.

IBM CABLING SYSTEM

IBM's goal in creating and supporting the IBM Cabling System is to try to ensure a stable environment for the operation of its computer equipment. Yet IBM does not sell the cables or connectors it describes in its documentation. You can buy cables and parts certified to meet the IBM specifications from a variety of vendors, and you can find local contractors who will install the premise distribu-

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LANDesk Manager also features Application Monitor, a breakthrough tool that has U.S. patents pending.

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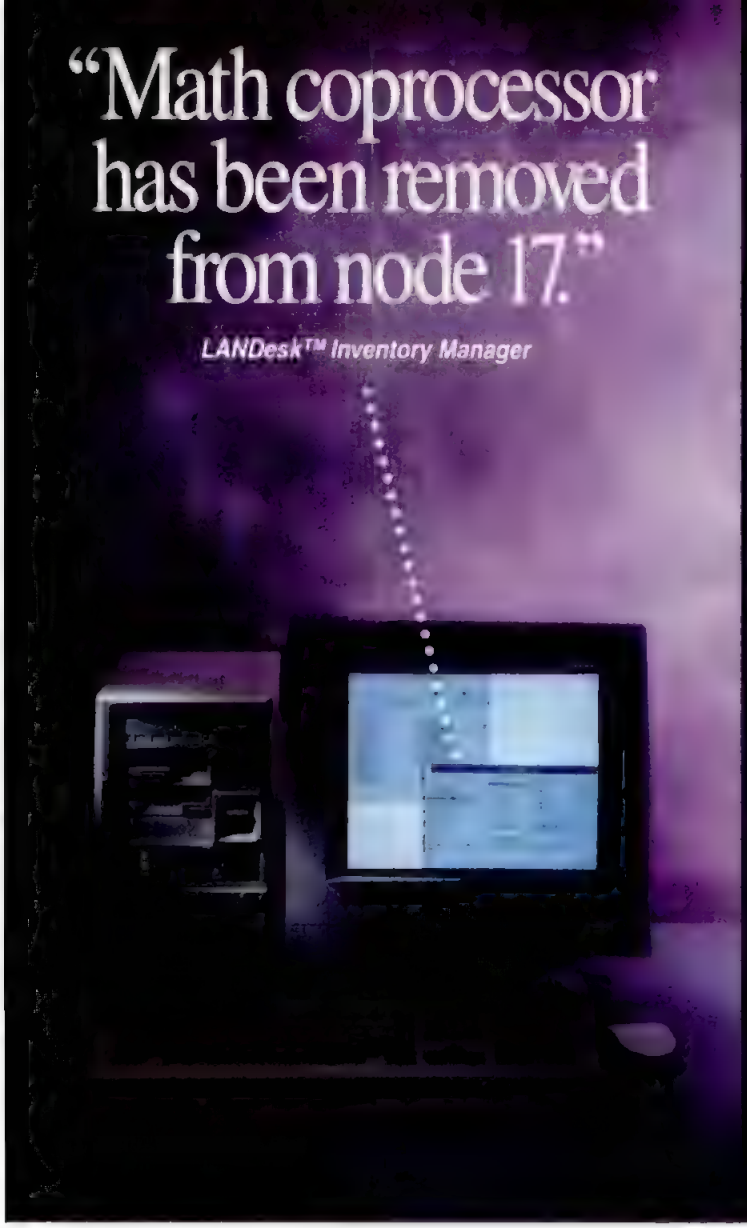

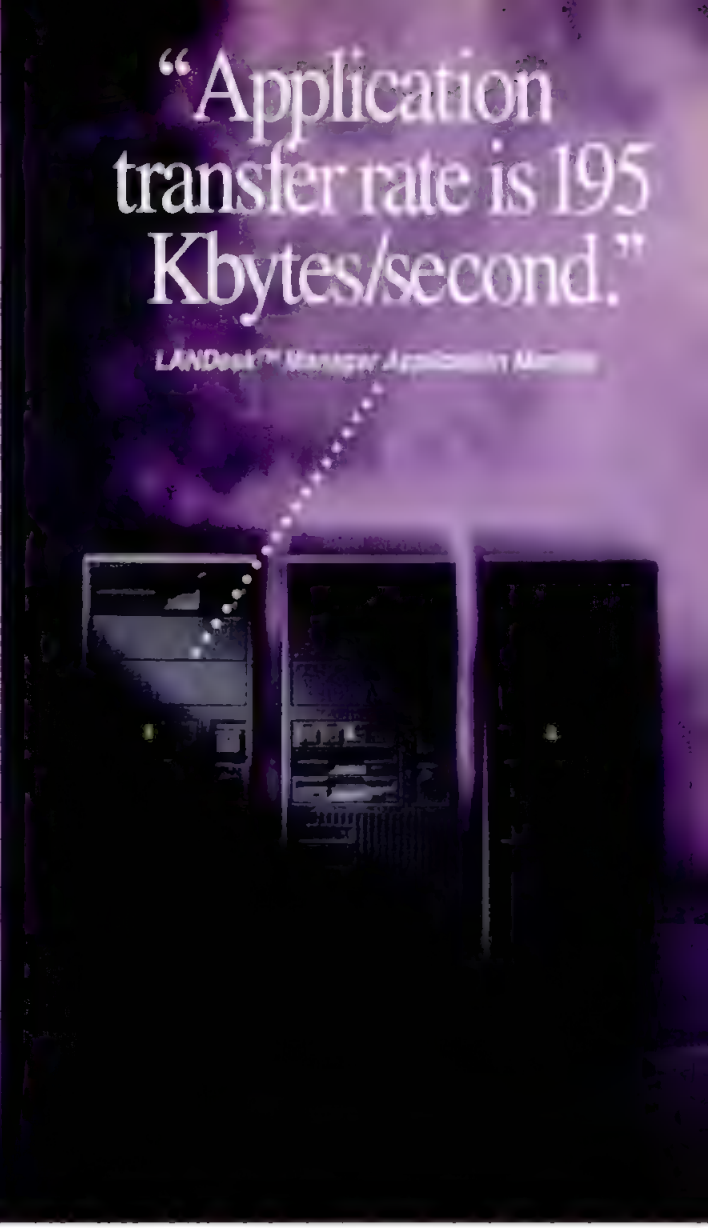

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intel

CIRCLE 882 ON READER SERVICE CARD

tion system according to IBM's specifications.

The heart of the IBM Cabling System is a series of specifications for cable types for use with all IBM products. The architecture contains the only significant support in the industry for shielded twisted-pair wire (STP). Specified in IBM's Type 1, Type 2, Type 6, and Type 9 cable, shielded twisted-pair wire replaces the older RG-62 coaxial cable that IBM used in order to link terminals to mainframe computers under the IBM 3270 terminal plan. STP is the wiring alternative IBM recommends for both 4-megabit-per-second and 16-megabit-per-second Token-Ring installations. The IBM cabling plan also uses fiber-optic cable and UTP, but the heart of the system is shielded twisted-pair wire.

The primary advantage of IBM's Cabling System is its conservative engineering. IBM relies on heavy shielding around all pairs to keep electrical noise out and both shielding between the pairs and twisting to reduce cross-talk between the pairs. The specifications keep wiring runs short to avoid problems caused by the degradation of the signals over distance. If the installer follows the plan, the cable system will work in practically any electrical environment and be viable beyond the life of the computer equipment.

The primary drawback to the IBM cable plan is the heavy bulk of the shielded twisted-pair cable. Type 1 cable, which can have an outside diameter of between .32 and .5 inches—depending on the manufacturer and the type of outside jacket—quickly fills wiring conduits and cascades into wiring closets in a huge waterfall of cable.

Another significant drawback to the IBM plan is the cost of the cabling and the connectors. You'll pay approximately four times as much per foot for Type 1 cable as you would for the highest-quality UTP designed for the same LAN signaling speed. The IBM Data Connector used on Token-Ring hubs costs about 16 times as much as the RJ-45 connector typically used on UTP and is also about 16 times as large. So while it might be good, IBM's cable plan is bulky and expensive.

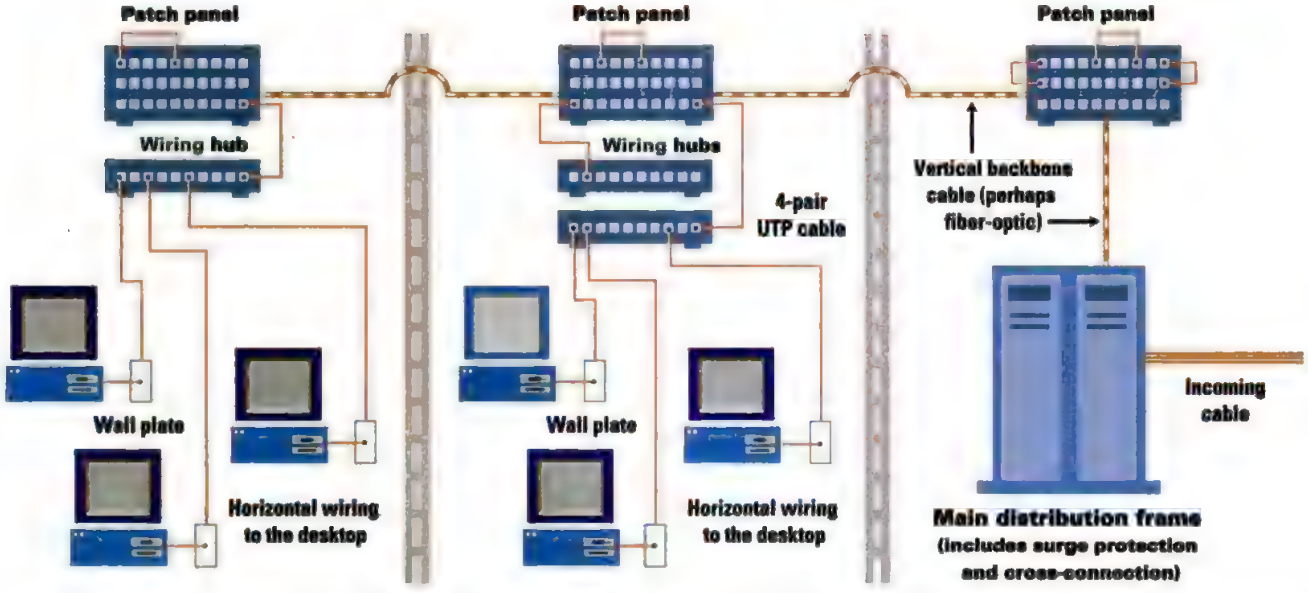
AT&T SYSTIMAX PDS

AT&T's Systimax PDS is more versatile than the IBM scheme. Systimax PDS provides a flexible, reliable, and expandable cabling plant that originated in part from the Bell Standard Practices (BSPs), a series of publications that controlled the technical side of the telephone industry prior to the breakup of the Bell system.

Unlike IBM, AT&T manufactures, sells, and installs the products in the Systimax family. The company also offers installation training, so you will find many installers in local companies who know how to work to Systimax specifications.

And while IBM focuses primarily on shielded twisted-pair cabling, the core of the Systimax plan is UTP for horizontal cabling (the cable from wiring closet to the desktop) and fiber-optic cabling for everything else. A 3-inch stack of AT&T catalogs describes all of the products in the Systimax line, but the basic Systimax 100-ohm impedance cable for horizontal data wiring uses four pairs of UTP 24 AWG (American Wire Gauge) copper wire. The cable provides two spare pairs in most installations. With an outside diameter of about .17 inches, these cables are much easier to pull through conduits and inside walls. The Systimax specifications allow a cable run of 100 meters for data transmission at speeds of up to 16 megabits per second (Mbps).

Premise Distribution System



Premise distribution systems (PDSs) consist of cabling and several components integrated to link PCs, printers, mainframes, and a host of other devices.

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CIRCLE 894 ON READER SERVICE CARD

AT&T also specifies a cable combining copper and fiber-optic conductors. It provides a total of eight unshielded twisted pairs and two fibers inside one jacket. This combination offers plenty of bandwidth for data and voice telephone connections to any desktop and the capability to add fiber connections for higher-speed data, video, or other applications. If you have a big budget and plan to own the building forever, we think this is the right stuff to install, but it is expensive and bulky.

AT&T offers a variety of fiber-optic cables to link wiring closets and as horizontal wiring for special applications. Some products in this family use as many as 216 fibers together inside a protective jacket for the long trip up an elevator or air shaft. The AT&T fiber-optic standard calls for 62.5/125-micron multimode fiber with windows at 850 nanometers (nm) and 1,300 nm and a bandwidth of 160 MHz and 500 MHz.

Cross-connection and termination equipment gives a PDS its flexibility, but as a rule a cable system is no better than its connectors and terminators. The AT&T 110 Connector System family of products has set the standard for the industry. These products include several types of rack- or wall-mounted connector hardware that typically goes into a wiring closet to terminate horizontal and backbone cable.

AT&T takes the wiring to the desktop. The company offers a variety of wall outlets that terminate eight conductors for data and voice connections. The wiring sequence for these jacks—which wire goes to which pins—is critical to the proper operation of the network. AT&T's Standard 258A is the most widely specified wiring sequence for four-pair plugs and jacks. It is also the same as the wiring sequence specified for Integrated Services Digital Network (ISDN) and 10BaseT Ethernet over UTP. However, the AT&T 258A standard puts pairs 2 through 4 in a sequence that is different from the older Universal Service Order Code (USOC) sequence used by many local telephone companies. This difference in sequence is a primary cause of problems when data networks are added to older wiring systems.

AMP AND MOD-TAP

Many companies manufacture or sell PDS components, but two companies, Amp and Mod-Tap, stand head and shoulders above their competition in terms of providing consistent quality, training, and support of their products. These companies don't attempt to set PDS standards. Instead, they market cable and connection products that conform to popular standards while also innovating and providing improved convenience and quality.

Amp and Mod-Tap stand head and shoulders above their competition in providing consistent quality, training, and support of their products.

Both Amp and Mod-Tap have training programs for installers.

Among its many products, Amp markets the Ampix Cross-Connect System, a distribution system for voice and data that includes specially designed high-quality wire terminations and printed circuit board connections between the wire termination and the RJ-45 jack of the patch board system. Amp also has a wide variety of fiber-optic cable splicing, terminating, and testing equipment.

Mod-Tap's product line stresses flexibility. The company markets products that meet the requirements of AT&T, IBM, Digital, and many other companies as well as standards committees. Mod-Tap also boasts an excellent line of fiber-optic products that ranges from the cable itself to connectors and splicing equipment and supplies, and the company also offers products from wall plates and connectors to all the components of a distribution frame.

EIA/TIA

The EIA/TIA specifies categories of cables, such as coaxial and different types of fiber-optic, that are not covered by AT&T or IBM. The EIA/TIA cable categories were developed by Amp and other companies. The result is the EIA/TIA 568 Standard for Commercial Building Telecommunications Wiring.

The primary advantage of EIA/TIA 568 is that it's an open standard: You can select and specify cables meeting a specific category of the EIA/TIA 568 standard and expect to get comparable bids back from a variety of vendors.

The EIA/TIA standard describes both the performance specifications of the cable and its installation. However, the standard still leaves the network system designer room for options and expansion. The standard calls for running two cables, one for voice and one for data, to each outlet. One of the two cables must be four-pair UTP for voice. You can choose to run the data on another UTP cable or a coaxial cable. If you elect to run fiber to the desktop, it can't displace the copper data cable if it is already present.

Trying to describe the EIA/TIA 568 standard and the category system is like trying to paint a moving train. The standard evolves through an interactive committee process, and change—particularly expansion—is a constant process. Since IBM's 150-ohm shielded Type 1 and Type 9 cable is so important in the market, for example, we expect to see it accommodated in the standard. There are proposals that also integrate thin net Ethernet coaxial cable, 62.5/125-micron multimode fiber, and single-mode fiber cable used for long distance connections into the specification.

NATIONAL ELECTRICAL CODE

Snaking flammable cabling throughout a building creates a major fire hazard. Several organizations, including UL, have established standards for how cabling should burn. The standard most widely used by local licensing and inspection officials is the NEC.

The NEC is a legal document called a *code* that legislative bodies can easily adopt into law. The code, among other things, sets a limit to the maximum amount of time that the cable should burn after a flame is applied. Other standards that were developed by the NFPA and adopted by the American National Standards Institute describe the type and

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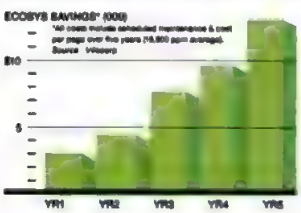

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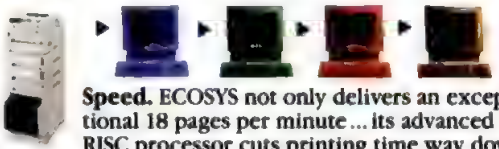

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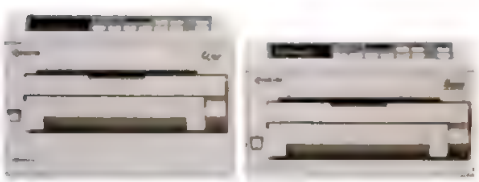

FS-3500A 18 ppm FS-1500A 10 ppm

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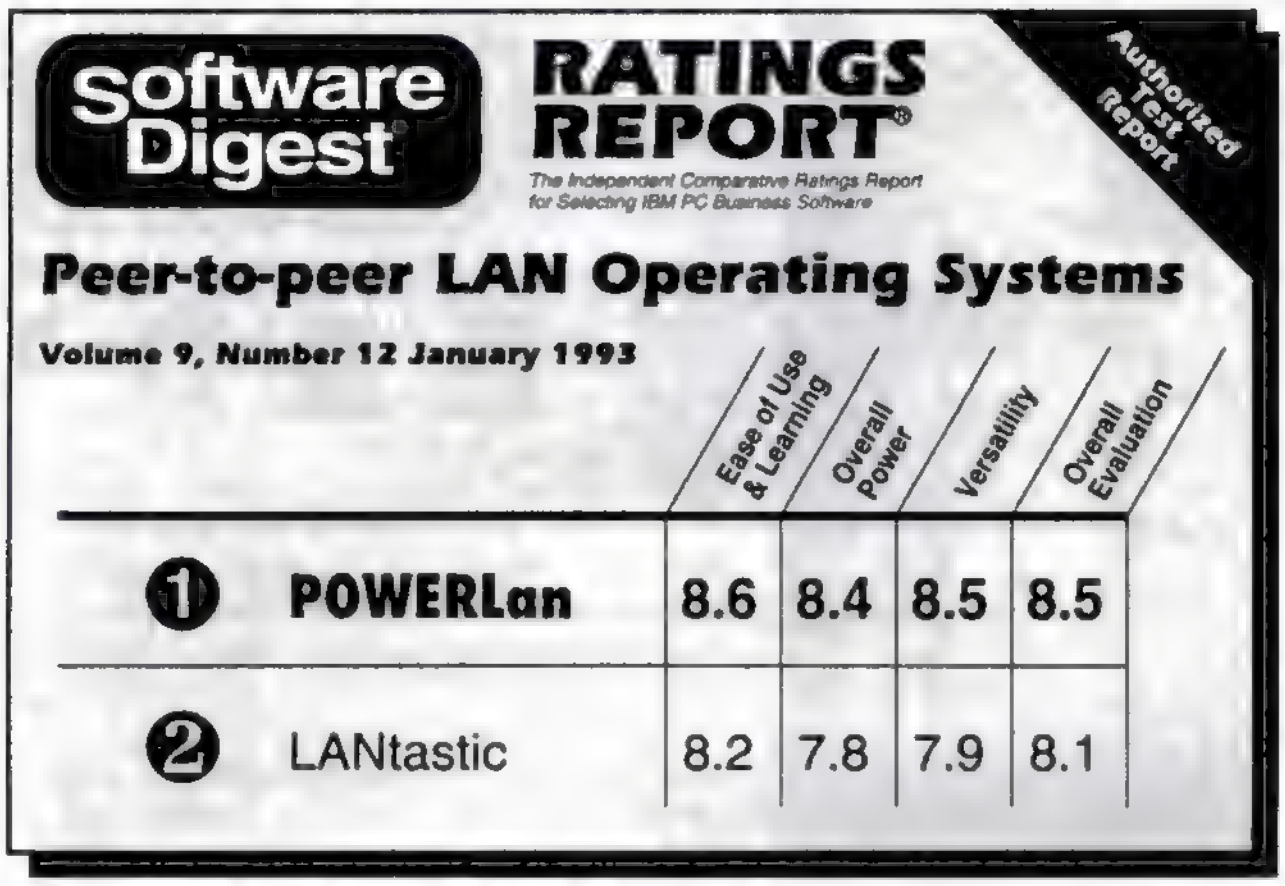

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PERFORMANCE TECHNOLOGY

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amount of smoke a burning cable should generate.

While the industry recognizes and generally acknowledges conformance to the NEC standards, every individual municipality, city, county, or state can decide whether or not to adopt the latest version of the NEC for local use. In either case, we urge you to select cable that meets the NEC codes.

You'll see NEC codes listed in catalogs of cables and supplies. These codes classify specific categories of copper cabling for specific types of use. Generally, you'll find LAN cables listed in the category of type CM (communications) or type MP (multipurpose). There are two additional categories: remote-control (CL2 or class 2) and power-limited circuit cable (CL3 or class 3). The flame and smoke restrictions are generally the same in these two categories. The difference between these four categories is the amount of electrical power that could run through the cable under the worst case. MP cables can handle the most power with CM, CL3, and CL2 going through tests with decreasing levels of power handling.

Type designations OFC and OFN cover fiber-optic cables. Type OFC fiber-optic cable contains metal conductors, inserted for strength; type OFN cable contains no metal.

The cable types have a letter designating their use. The letter P in type CMP, Communications Plenum cable, designates a cable that passed tests showing a limited spread of flame and low production of smoke. Plenum cable is typically coated with a special jacket material such as Teflon. The code defines a plenum as a channel or duct work fabricated for handling air. A false ceiling or floor is not a plenum.

The letter R in type CMR, Communications Riser cable, shows that the cable has passed similar but slightly different tests for the spread of flame and production of smoke. Riser cable, for example, is tested for its burning properties in a vertical position. According to the code, you must use cable rated for riser service whenever a cable penetrates through a floor and a ceiling. Riser cables typically have a polyvinyl chloride (PVC) outer jacket.

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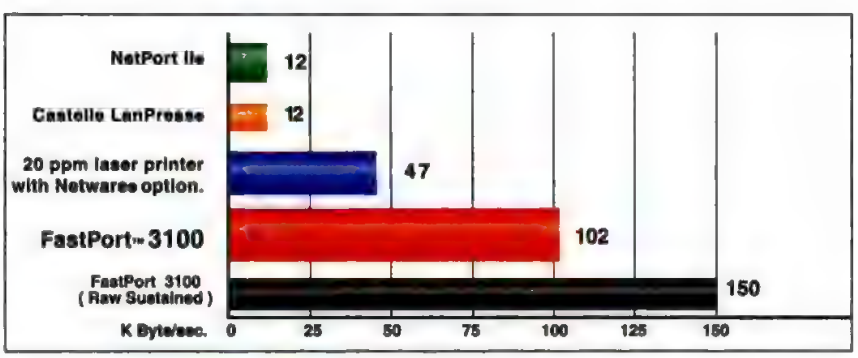
Actual throughput transfer rates for .7 megabyte file on a 486 NetWare network. Time reflects time to transfer print job to printer from the Novell® server after being queued and polled. Does not include time to print.



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CIRCLE 879 ON READER SERVICE CARD

UNDERWRITERS LABORATORIES

Local fire and building code regulators try to use standards similar to the NEC, but insurance groups and other regulators often specify the standards of the Underwriters Laboratories. UL has safety standards for cables that conform to the NEC. UL 444 is the Standard for Safety for Communications Cable, and UL 13 is the Standard for Safety for Power-Limited Circuit Cable. Network cable might fall into either category. UL tests and evaluates samples of cable and then, after granting a UL listing, conducts follow-up tests and inspections. This independent testing and follow-through makes the UL markings valuable tools to buyers.

In an interesting and unique action, the people at UL stirred safety and performance together in a program designed to make selecting or specifying a cable easier.

UL's LAN Certification Program addresses not only safety, but also performance. IBM authorized UL to certify 150-ohm STP as compliant to IBM performance specifications, for example, and UL established a Data-Transmission Performance-Level Marking Program that covers 100-ohm twisted-pair cable. UL adopted the EIA/TIA 568 performance standard and, by evolution, the Anixter cable performance model. There is a small inconsistency, however: The UL program deals with both shielded and unshielded twisted-pair wire, and the EIA/TIA 568 standard focuses on unshielded wire.

UL's LAN Certification Program addresses not only safety, but also performance.

The UL markings range from Level I up through Level V. You can tell a UL level from an Anixter level because the UL level is represented by Roman numerals. As we have described, IBM's cable specifications range from Type 1 through Type 9 while the EIA/TIA has Category 1 through 8. It's easy to become confused by the similarly numbered levels and types. The UL level markings deal with performance and safety, so the products that merit a UL level also meet the appropriate NEC specifications, along with the EIA/TIA standard for a specific category. Cables that earn these UL markings can show them on the outer jacket as, for example, Level I, LVL I, or LEV I.

A STAR TO STEER BY

As you navigate through the landscape of your network's cabling system, it is often difficult to see the forest for the trees. While cable testers will detect cabling faults once the network is in place, a thorough understanding of these cable and wiring plant standards is absolutely crucial when you're in the process of developing a network. Structured architectures such as premise distribution systems, the EIA/TIA guidelines, or the UL marking system provide some assurance that you can pick the right path to network success.

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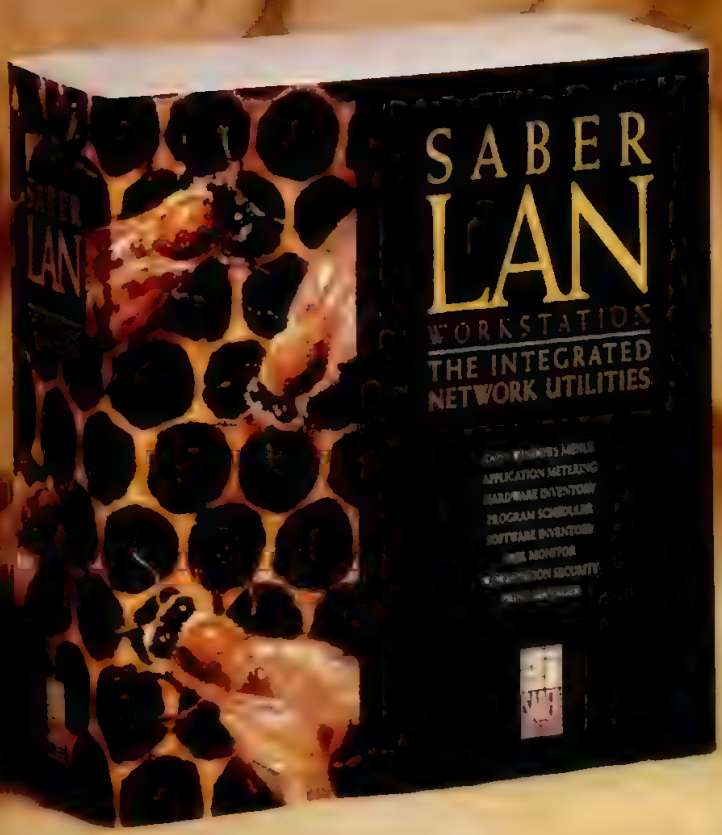

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FIRST LOOKS

HANDS-ON EVALUATIONS OF THE NEWEST NETWORK PRODUCTS

▶ ROUTERS

Dial-Up Router Makes Internetworking Cheap

BY ROBERT LIPSHUTZ

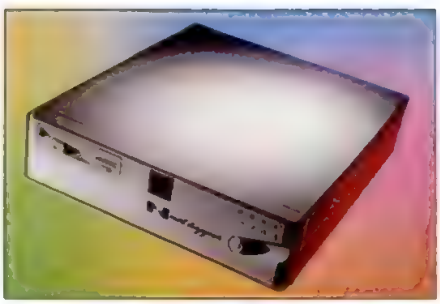
Routers don't have to be difficult to install. Rockwell International's new NetHopper I brings low-cost, easy-to-install routing to the workgroup.

However, it only supports IP and Ethernet networks and lacks support for major protocols such as IPX and AppleTalk and LAN topologies such as Token-Ring. But if you only need to pass IP packets, then the NetHopper may be for you.

The unit is a self-contained dictionary-size box with a floppy disk drive, a 14.4-kilobit-per-second (V.32bis/V.42bis) modem, and one Ethernet port.

Traditional routers remain difficult to configure and require either an expensive leased line or access to a switched network, such as X.25 or frame relay, to connect remote offices. The NetHopper router solves both problems by using an integrated modem to connect to a dial-up phone line. With an integrated modem, there are no compatibility headaches, letting you install the router in under 30 minutes. This makes NetHopper perfect for connecting small remote sites, backing up a leased line for corporate IP networks, or connecting to the Internet.

Once installed, the router is easy to manage, using the Simple Network Management Protocol (SNMP). The router supports MIB II objects and traps specified by SNMP as well as a proprietary MIB, which gives information on the configured IP filters and provides administrators with several layers of control. PING and TraceRoute, two common TCP/IP network utilities, are also supported. Finally, with the ability to filter IP protocols, the NetHopper can restrict data on the LAN to internal users.



Easy access: The NetHopper I cuts WAN costs and installs in minutes.

As a dial-up router, the NetHopper does not have a permanent connection to the attached network; it creates a connection when it receives data destined for a remote station. The delay can be about 30 seconds, and during that time the router can't buffer any frames. Rockwell recommends PINGing the desired destination before attempting Telnet, File Transfer Protocol (FTP), and other applications that may time-out before a connection is initiated. Once established, the phone line will remain alive for 4 minutes (user-configurable) after the last packet is sent.

The NetHopper should work with all other routers supporting Asynchronous Point-to-Point protocol. It has been tested with the Telebit NetBlazer, the Centrum Remote Access Server, the Livingston PortMaster, and the Cisco CS-500 communications server.

A User Guide, Technical Reference Manual, and Quick Reference Guide make the NetHopper easy to install, even if you have never used TCP/IP before.

The NetHopper can bring you into the router market or supplement your existing router jungle. In either case, you can set this router up during the week and leave the weekends for other adventures.

• List price: *NetHopper I, $1,995. Rockwell International, CMC Network Products Division, 7402 Hollister Ave., Santa Barbara, CA 93117-2590; 800-262-8023, 805-968-4262; fax, 805-968-6478.*

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▶ DRIVE CONTROLLERS

RISC Power Boosts Drive Array

BY JAMES KARNEY

With its new FlashServer, Winchester Systems ushers in the next generation of high-performance host adapters. The FlashServer is the first small computer system interface (SCSI) host adapter to combine a pure 32-bit design and a RISC architecture. It also has a large cache (up to 32MB) to boost I/O performance tenfold.

Though some vendors have used RISC designs on controllers, they have done so primarily to manage the overhead of RAID-5 design, according to Winchester Systems. New SCSI adapters from vendors such as NCR Corp. and Adaptec will offer additional 32-bit architectures with

Photograph by Robert Cardin

RISC processors to users this summer.

The FlashServer comes with two SCSI channels (twice that of normal SCSI cards): RAID Levels 0 (striped), 1 (hardware duplex).

Powering the FlashServer is an INMOS T400 transputer, a high-performance RISC processor commonly used in mainframe disk channels, coupled with two NCR 53C700 SCSI RISC processors.

Since this is the first adapter of its type, we were unable to compare it with comparable products. We did, however, compare it with two popular controllers (UltraStor Corp.'s U34F and BusLogic's 747), both running off of a VL-Bus.

All adapters were loaded into a Compaq ProSigna 486DX/2 66-MHz server with 32MB of RAM. The FlashServer was equipped with a 32MB cache. Hanging off it was a Winchester 2GB RAID 1– and RAID 0–compliant drive array with DOS 5.0 and NetWare 3.11. Comparable SCSI-2 drives were used with the other controllers. A Micronics VL-EISA workstation with 12MB RAM, a VL-Bus, Fast SCSI-2 adapter, and matching drive was attached to the server using Etherlink III cards via 10BaseT.

The products were tested using PC Magazine Labs' disk benchmark tests, which stress the controller by generating a series of sequential and random requests from 256K to 32MB. The requests ranging from 256K to 512K are more common and thus carry a heavier weight. The FlashServer scored 268.9 kilobits per second, while the average for both the UltraStor U34F and the BusLogic 747 was 25.3 Kbps.

FlashServer wasn't any more complicated to install than any other SCSI adapter. You will, however, need to add a daughterboard to give external devices access to both SCSI channels.

Winchester Systems sells the FlashServer through resellers. With its 32-bit architecture, the FlashServer is a powerful addition to any frequently accessed file server or application server.

• List price: *FlashServer, $5,995 with a 32MB cache. Winchester Systems, 400 W. Cummings Park, Woburn, MA 01801; 800-325-3700, 617-933-8500; fax, 617-933-6174.*

Circle 952 on reader service card

▶ CONFERENCE SOFTWARE

Synconference Ties Remote Workgroups

BY STEVE RIGNEY

Talk about enterprise workgroup. Synconference, Version 1.0, turns your PC into a remote slide projector. By running Synconference on two PCs you can show a slide presentation without leaving the office. The savings on airline tickets alone would be reason enough for buying the package, if not for one major failing: The package doesn't easily work with such leading presentation packages as Microsoft PowerPoint and Lotus Freelance Graphics.

Synconference runs over Windows 3.*x*. The package consists of three utilities for capturing Windows screens, creating and modifying slide show presentations, and presenting and transfering your slides.

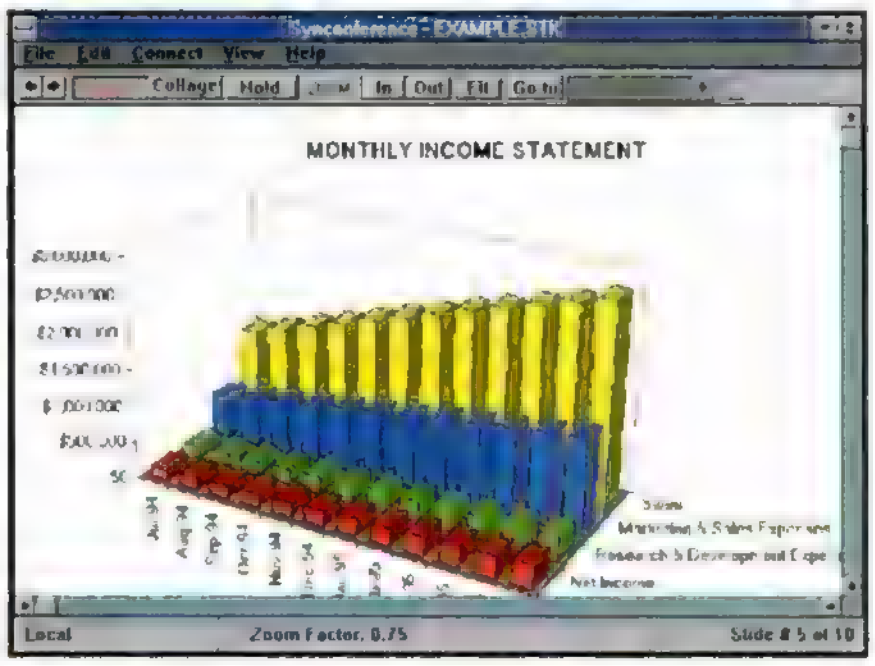
CREATING A PRESENTATION

You begin Synconference by creating a presentation using BMP, PCX, TIF, or GIF graphic file formats. Documents from other packages cannot be added to the presentation unless the screens are first captured using Syncap or some other utility.

After you have created all of your screen shots, Synconference creates an information file that includes the order of your slides and the file names of the individual screen shots. However, the file lacks the presentation itself, which is provided by leading presentation packages such as PowerPoint. This makes keeping track of each slide of your presentation more difficult. If you create a lot of presentations, you may have to contend with tracking 100 files, not 10 or 20.

Once you create and compile the slides, you can organize and change them with a click of the mouse. When ready, Synconference sends the file to a remote PC using a basic Zmodem-based communications protocol. Then the two PCs running Synconference exchange commands and directions over the telephone lines. By passing the file prior to the presentation, you can run acceptable slide shows with a throughput of only 1,200 bps. Synconference will support throughput of up to 19,200 bps, which is only needed during the initial transfer.

During the presentation, you can use a mouse to move a pointer around the screen to highlight important features or ideas. The design of the product assumes two phone lines: one for speaking, the other for passing slide-show information. This scenario is ideal for use with a product such as the Multi-Tech Personal Communication System, which allows you to share voice and data over a wire.



Remote blackboard: Synconference lets you show a slide presentation on a remote PC.

The Synconference includes a two-PC license to initiate a remote connection and to create a slide show. Also included in the package is a Listen Only copy of the program for unlimited users. The Listen Only version allows any remote PC to observe or direct a presentation but does not allow you to initiate a remote connection or create a slide show. Synconference provides an economical way to present a slide show to a client or colleague. But its weak file support and organizational features make Synconference limited at best.

• List price: *Synconference, Version 1.0, $395. Modus Software Inc., P.O. Box 1935, Los Altos, CA 94022; 415-964-1936; fax, 415-964-4620.*

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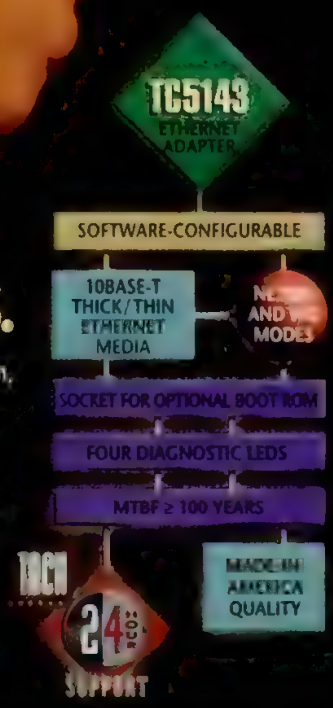

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NETWORK MANAGEMENT

VisiNet Manages Peer-to-Peer LANs

BY STEVE RIGNEY

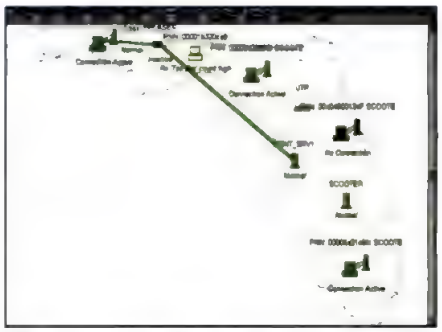
While peer-to-peer LANs may be inexpensive and easy to install, they are especially difficult to manage in large installations. VisiSoft hopes to solve this problem with its new network management package, VisiNet Enterprise 2.0. VisiNet is the first management platform to bring the ease of management of dedicated server networks to peer-to-peer LANs.

Enterprise 2.0 is a Windows-based application that gathers network inventory information from both clients and server. Unlike many other management solutions, Enterprise 2.0 works over NetBIOS, which is supported by most peer-to-peer LANs, NetWare 2.*x* and 3.11, Advanced Server, and a Simple Network Management Protocol (SNMP) agent for communicating with a network management console such as SunNet Manager. The rest of the options are available as separate modules.

VisiNet Enterprise offers six different functions: Inventory Management, Object Templates, Views and Icons, Nodes and Links, Scripts, and Real-Time Monitoring and Alarms, as well as a detailed report generator. However, VisiNet's strongest feature is its ability to depict your network graphically with color icons and maps.

VisiNet Enterprise is as easy to install as any Windows application. Once installed, VisiNet creates a map of your network. Unlike many other management products, VisiNet saves the network manager time by automatically gathering network information and representing network devices as objects on this map.

When configured with the NetBIOS module, VisiNet will gather this information from every NetBIOS client and server on the LAN. If you are running VisiNet with its SNMP module, the application will also indicate which nodes offer SNMP agents. Finally, if the station is running the right module, VisiNet will offer you a graphical representation of it.



Instant Perspective: Automatically map your network.

VisiNet provides standard object templates for viewing and monitoring 31 different types of devices. The Object Templates feature defines the specific characteristics for each node or object on the network. An object template for a file server, for example, would contain fields

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for connection information, and also general hardware information such as type of CPU. Each template can contain up to 129 fields.

These data fields are automatically filled out in two ways. Every time a user logs on to the network, VisiNet's HQSCAN program scans that PC and gathers hardware information such as CPU type. The Inventory Management utility automatically scans the network to discover nodes that have not run the HQSCAN programs. The VisiNet Automatic Scan utility provides information on network address, log-on name, and traffic patterns.

ALERTS AND NOTIFICATION

Once the information is gathered, you can create alternative views of the network information. A single view can represent an office, a building, a city, or the world. Each view is user-defined, so you can easily create a picture of your network. VisiNet includes background maps of all the countries, along with different icons that you can use to represent objects on your network.

The Nodes and Links function presents each device on the network as well as the connection between them. Both nodes and links have a state assigned to them. If a server, for example, is functioning correctly, it is shown as green; if the server fails or starts sending bad packets, it changes to a yellow warning color. You can then view the configuration and management information for each node and link by clicking on the desired object.

VisiNet provides detailed information concerning every node on your managed network.

If a problem should occur, VisiNet can also alert you through an alarm. These alarms can easily be changed, allowing you to increase a certain node's sensitivity to network traffic.

Tying these features and functions together is a powerful scripting language for manipulating user-defined fields, states, and alarms. The scripting language allows you to write macros that receive and send information to other Windows applications using Dynamic Data Exchange (DDE).

A powerful report generator stores the information generated by VisiNet. The program keeps a Log Review Table containing the information about all managed nodes. You can print the full log or customize your own reports for output.

Visinet offers a complete graphics network management solution for peer-to-peer and server-centric network operating systems.

• List price: *VisiNet Enterprise System 2.0, with NetBIOS module, $795; NetWare and LAN Manager module, $705; SNMP agent, $1,700. VisiSoft, 2700 Northeast Expressway, Suite B-700, Atlanta, GA 30345; 404-320-0077.*

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GATEWAYS

Firefox's Novix Simplifies Linking NetWare with TCP/IP

BY JIM QUEEN

Novix for NetWare, Version 2.0, is a full-featured TCP/IP gateway that allows any NetWare 2.*x* or 3.*x* user to access Internet Protocol (IP) hosts without the headache of assigning and maintaining IP networks and individual addresses. Properly configured, it can even give every user on your network access to the Internet without consuming precious memory at the client. Instead of running a TCP/IP stack at each client, it runs the TCP/IP stack as a NetWare Loadable Module (NLM) or value-added process (VAP).

Unfortunately, network managers who hoped to save money by eliminating the need to purchase Novell's TCP/IP solution, LAN Workplace for DOS, for each client will probably be disappointed—a five-user version of Novix for NetWare lists for $1,495 with larger quantities bringing the price to around $100 per concurrent user—about the same price as running a protocol stack on the desktop.

As the protocol of choice for corporate backbones, TCP/IP has gained a strong following in large installations. Unfortunately, this means NetWare users need to use the TCP/IP protocol rather than the IPX protocol found in NetWare in order to access these corporate resources. However, this creates a real management problem. Under TCP/IP, each station must be assigned a complex network address. Administrators need to be sure that each of these addresses is unique; otherwise, the network won't work. A database of addresses then needs to be maintained and updated for each station added to the network.

While most solutions let users run TCP/IP and IPX at their desks, Novix solves this problem by putting the TCP/IP stack on a separate machine. Special software converts NetWare requests and responses to TCP/IP requests and responses. This allows NetWare users to share a single TCP/IP address, avoiding the addressing management nightmare.

This latest version of Novix for NetWare provides some long-awaited enhancements; most notably, DOS and Windows VT-220 terminal emulators.

This latest version of Novix for NetWare provides some long-awaited enhancements; most notably, thanks to its OEM agreement with Novell, Firefox now includes the DOS and Windows VT-220 terminal emulators as well as the File Express (a Windows-based file-transfer application) and File Transfer Protocol (FTP) programs from Novell's TCP/IP package, LAN Workplace for DOS.

In addition, Version 2.0 offers excellent security functions, with the ability to limit access to Unix hosts based on physical network addresses or NetWare bindery groups and names. Bidirectional printing is supported for many TCP/IP hosts. This allows NetWare users and TCP/IP users to share network printers. Licensing is now managed via software, so the parallel port device required to restrict licensing by earlier versions is no longer required.

Novix for NetWare can be administered either by using its own Host Connect Management software or by remote console access to the NetWare server. However, we did find a conflict between Novix and Version 1.15 of NetWare's NetWare Management System (NMS) software: The Novix server software intermittently disconnects from the client when NMS is loaded at the server.

Installation was pretty straightforward. In fact, establishing basic file transfer and terminal access rights took about 10 minutes. There were a few problems, though: Establishing a default router, for example, required entry of an existing network address instead of zeros, which is normally required.

On the client, you need to create a NET.CFG file in the root directory of the boot disk. In a future release, Firefox plans to allow you to move this file to another location. The NET.CFG provides path information for the Novix LAN Workplace utilities.

Novix for NetWare offers several ways to access TCP/IP hosts—the easiest is VT-220-4, a DOS program designed to communicate directly with the Novix server. A separate utility, NVFTP, allows you to easily transfer files to and from Unix hosts.

However, you'll probably prefer to use the LAN Workplace utilities shipped with Novix for NetWare. These programs and other third-party utilities that support DOS INT 14 require you to load a TSR before starting Windows. For Telnet or VT terminal emulation, the TSR requires 25K—FTP functionality requires a 48K TSR. With this driver loaded, all LAN Workplace utilities, including Host Presenter and File Express, work as if the client had the full TCP/IP stack loaded.

Despite a few minor installation and configuration problems, Novix is an effective solution for integrating TCP/IP and NetWare. It dramatically reduces the problem of managing multiple IP addresses and simplifies the overall management of the TCP/IP-to-NetWare connection.

• List price: *Novix for NetWare, Version 2.0, $1,495 for a five-user version. Firefox Inc., P.O. Box 8165, Kirkland, WA 98034-0165; 206-827-9066; fax, 206-827-8285.*
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UNIX REVIEW

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COMMUNICATIONS SERVERS

Microdyne Server Makes Remote Control Simple

BY JEFFREY L. CARRELL

Communications servers come in all different flavors, but the NetWare Access Server from Microdyne stands out from the rest for its combination of unique software architecture and powerful hardware design.

Originally developed by Novell as a software product, the NetWare Access Server (NAS) is now bundled by Microdyne with a hardware platform optimized as a communications server. You can still build your own NAS by purchasing the software separately from Novell, but you'll find the Microdyne version a lot easier to install and more reliable.

The latest version of NAS, Version 1.3, provides many of the features the user community has been asking for: Windows support, mouse support (for both DOS and Windows), Zmodem for file transfer, and increased memory in the NAS hardware.

Remote Control: With remote control, the user gains higher performance (since only the keyboard and screen functions are passed) and easier management (since everything is centralized).

The platform is built around a 386DX/33 computer that features a memory manager, built-in modems, and a network adapter. The product can service up to eight simultaneous dial-in users with data rates up to 38,400 bps and error correction.

There are two components to the software. On the server, the multitasking kernel services function establishes up to eight virtual 8086 processors, each of which is controlled by the remote user's PC. The remote computer runs either OnLAN/PC or OnLAN/Mac. OnLAN is a customized version of Symantec Corp.'s pcAnywhere/LAN remote control software. Both packages allow the remote user to run applications locally on the NAS.

Letting the user run applications on the NAS itself puts the NAS in the remote control camp of communications servers. In contrast, LAN modems such as Shiva Corp.'s NetModem/E allow the remote client to run applications locally and therefore become a node on the LAN. With remote control, the user gains higher performance (since only the keyboard and screen functions are passed) and easier management (since everything is centralized). However, the remote node is typically easier for the end-user and more difficult to troubleshoot.

We looked at a four-port NAS configured with a 10BaseT network connection, 16MB of RAM, and four built-in modems. The NAS was connected to a NetWare 3.11 Ethernet and Token-Ring network. On the LAN, there were three clients: two 386SX/16 workstations—one with a 2,400-bps modem and a Token-Ring connection and one with a 14.4K-bps V.32bis modem—and an Ethernet connection and a Macintosh IIx with a 2,400-bps modem and an Ethernet link. All three clients were used to connect to the NAS on both dial-in and direct LAN connections.

The product was very easy to install, and performance was good, but don't attempt to run Windows on anything slower than a 9.6K-bps line. Even then,

The latest version of NAS, Version 1.3, provides many of the features the user community has been asking for.

Windows must be installed on your file server, not on your communications server. Indeed, if there was any area where Microdyne's documentation needed some work, it was here: Microdyne should make using a working configuration of Windows easier instead of requiring installation of all Windows files onto a file server.

Overall, though, the documentation was quite clear and easy to understand. A step-by-step installation guide provides clear diagrams and instructions on installing the server. A second manual gives pertinent information and tips about the NAS and its operations and configurations, and both the PC and Mac OnLAN software packages come with manuals.

• List price: *NetWare Access Server, Version 1.3, $9,845. Microdyne Corp., 207 South Payton St., Alexandria, VA 22314; 800-874-4633, 703-739-0500; fax, 703-739-0558.*

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NETWORK MANAGEMENT

Bindview NCS Makes Bindery Management Simple

PC Periscope: Gather a wide range of statistics from networked PCs or generate configuration and inventory reports.

BY CRAIG ELLISON

With so many ways to configure a PC, it's little wonder that network administrators sometimes end up troubleshooting PCs more often than they develop the services on the network. For those people, LAN Support Group's new Bindview NCS, Version 3.1, is just the solution.

This management package lets you track server and client resources. You can not only find out what software and hardware have changed on a client's PC, but generate a report of server configuration and utilization with the same application.

Bindview NCS, Version 3.1, is a successor to LAN Support Group's Bindview. NCS (for Network Control System) adds the software and hardware inventory functions. Over the long term, though, NCS' architecture may be more important than these functions: Unlike previous versions, NCS uses a modular approach to documenting a LAN. The Server Information Module (SIM) and the Workstation Auditing Module (WAM) collect vital information from the server. The NCS console is the central program that provides report generation and scheduling, installation services, and alert management for the two modules.

The real strength of Bindview NCS lies in its powerful report generating capability. Data gathered about a file server's bindery (groups, security rights, etc.) or a workstation's hardware configuration and software inventory can be reported directly by the predefined reports or exported to spreadsheets, DBF files, or comma-delimited ASCII files. If the supplied reports do not provide you with the exact information you need, you can design your own reports sorted on any field and filtered on any criteria you specify. You could, for example, quickly generate a report showing which workstations are using a version of IPX earlier than 3.1 or NETX earlier than 3.31.

Unlike previous versions, Bindview NCS uses a modular approach for documenting a LAN.

The Reporter: Bindview NCS generates reports of server and user information and lets net managers track server and client resources.

Bindview NCS relies on Novell's BTRIEVE NetWare Loadable Module (NLM) or value-added process (VAP) as its database engine. For NetWare 3.11, a 9K NLM gathers 30 additional statistics that would be unavailable otherwise. No VAP is required for collecting NetWare 2.*x* file server statistics. Workstation hardware configuration, file auditing, and software inventory data is gathered by the two programs that typically run as part of the system login script. Workstation auditing intervals are fully configurable either globally or by workstation. Unfortunately, Bindview NCS cannot collect information about OS/2 or NetWare for Macintosh clients.

Workstation file management is a key feature of the workstation auditing module. This feature allows you to detect the existence of specific files, detect if a user has changed a tracked file, create an alert, or gather the changed file for inspection. Full-text searching of text files is also available. For example, you could search users' CONFIG.SYS for the text string DEVICE=C:\DOS\HIMEM.SYS and generate an alert based on the outcome. Each alert has user-definable priority levels and actions that can be keyed to any DOS command. You can also edit a retrieved file and queue it to download to that workstation on a future login. This is a very powerful feature, but it should not be confused with a full-fledged software distribution package such as Frye Computer Systems' Software Update and Distribution System. The LAN Support Group does, however, plan to introduce a software distribution module that will use the NCS console later this year.

Documenting a file server's configuration and inventorying workstation hardware and software can be a long and tedious task. Bindview NCS, with its powerful reporting engine that works with both the workstation and server modules, makes the task one that a network administrator can almost enjoy.

The NCS console and either the SIM or WAM module sell for $495. Additional modules sell for $395. SIM is licensed per server, while WAM is licensed per 100 users.

• List price: *Bindview NCS, Version 3.1, $495. The LAN Support Group, 2425 Fountainview, Suite 390, Houston, TX 77057; 800-749-VIEW, 713-789-0882; fax, 977-9111.*

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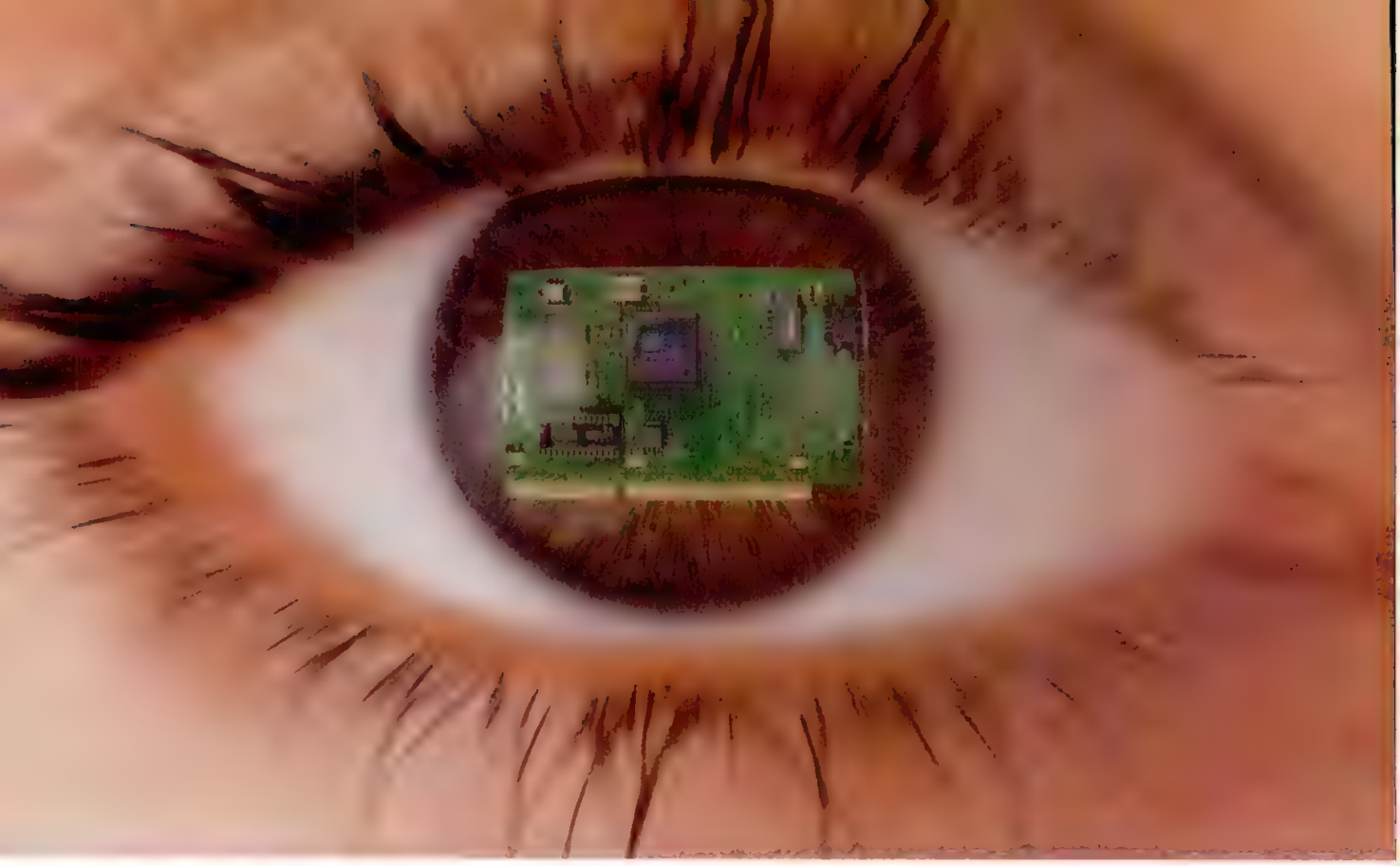

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NEW & IMPROVED

NEWS OF ANNOUNCED NETWORK PRODUCTS AND UPGRADES

NEW

Microsoft Mail Features Intelligent Messaging And StreetTalk III Directory Network Services

A new mail driver from Banyan Systems and Microsoft Corp. lets you use Microsoft Mail on Banyan's VINES and ENS for NetWare enterprise networks. The driver allows Microsoft Mail to be integrated with the Banyan Intelligent Messaging and StreetTalk III Global Directory network services. It eliminates the need for a separate e-mail network and reduces the cost of Microsoft Mail networking.

Users of Microsoft Mail will benefit from the combination of its mail-enabled applications with Banyan's Intelligent Messaging and StreetTalk III Global Directory, which provide automatic message transport and a directory infrastructure. StreetTalk Directory Assistance (STDA) is an added tool that can associate a name in a directory with a definable list of attributes, allowing Microsoft Mail to become a phone directory. Other features include dynamic routing and automatic message compression.

• List price: *Microsoft Mail driver for Banyan's Intelligent Messaging and StreetTalk III, free with Microsoft Mail and Intelligent Messaging. Banyan Systems Inc., 120 Flanders Rd., Westboro, MA 01581; 800-828-2404, 508-898-1000; fax, 508-898-1755. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-227-4679, 206-882-8080; fax, 206-936-7329.*

Circle 955 on reader service card

NEW AND IMPROVED

Microsoft Adds Forms Creation and Enhances Connectivity

Microsoft Corp.'s Electronic Forms Designer simplifies the task of developing, sending, and receiving electronic forms over the network. It lets Visual Basic users create forms for Microsoft Mail for Windows. Using open database connectivity (ODBC), users can retrieve and incorporate information from other database services. The product also supports Object Linking and Embedding (OLE), which lets it incorporate text and graphs from other desktop applications.

Microsoft also provides added connectivity with its shipment of the Microsoft Mail Gateway lines to IBM PROFS, fax, and MHS. Microsoft Mail Gateway to IBM PROFS and OfficeVision/VM is a host-to-LAN connection that provides built-in mail and scheduling abilities, Schedule+ interoperability, and the ability to send requests and track responses.

Microsoft Mail Gateway to FAX, Version 3.0a, includes a fax printer driver and allows users to send faxes from any Microsoft Windows application worldwide. Microsoft Mail Gateway to MHS, Version 3.0, supports global messaging.

• List price: *Microsoft Electronic Forms Designer, $395; Microsoft Mail Gateway to IBM PROFS and OfficeVision/VM, $4,995; Microsoft Mail Gateway to FAX, Version 3.0a, $1,995; Microsoft Mail Gateway to MHS, Version 3.0, $995. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-882-8080; fax, 206-936-7329.*

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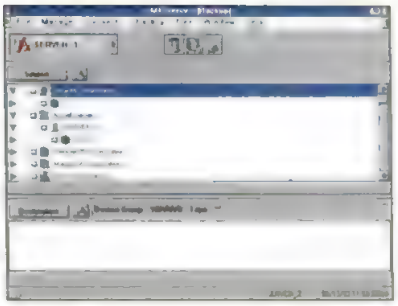
HOT PROSPECT

ARCserve 5.0 Backs Up Even the Largest LANs



BACKUP: Centrally manages servers and workstations.

Enhancements to Cheyenne Software's ARCserve 5.0 for NetWare: Windows Edition provide improved data management and security. The industry's leading client/server backup and recovery software now includes parallel streaming, tape cascading, stacker and changer support, and a Windows interface.

Cheyenne addresses previous versions' memory problems by utilizing Windows. The new version also features the "grandfather, father, son" strategy for tape rotation management. Integration with FAXserve and InocuLAN provides data management, virus protection, and communications.

•List price: *ARCserve, Version 5.0 for NetWare: Windows Edition, pricing based on number of users, $1,695 for 50 users. Cheyenne Software Inc., 3 Expressway Plaza, Roslyn Heights, NY 11577; 516-484-5110; fax, 516-484-3446.*

Circle 957 on reader service card

NEW

NetWorth Offers Segmentation with Stackable Hub

One of the first stackable hubs, NetWorth's Series 3000 TriSegment Stackable Hub (TSH), offers multiple segmentation.

The Series 3000 TSH features 24 ports, which you can separate into three 8-port groups, with each group maintaining a separate Ethernet network. Up to five hubs can be placed in a single stack, supporting 15 Ethernet segments and a total of 120 ports.

Series 3000 TriSegment Stackable Hubs provide multiple-segment networking for improved throughput and performance.

The TSH is offered in two Ethernet hub versions: the TriSegment Stackable Hub and the TriSegment Management Hub. The latter allows for interchangeable media connectors, including connectors for UTP (RJ-45 connector), thick net (AUI connector), thin net (BNC connector), and fiber Ethernet (FOIRL ST connectors).

The TriSegment Management Hub provides SNMP information and Novell Hub Management Interface (HMI) information, as well as support for NetWare's HubCon management utility. The user needs only one network manager hub to manage a stack of up to five hubs.

• List price: *Series 3000 TriSegment Stackable Hub, $1,995; STMM24 TriSegment Management Hub, $2,995; connectors and management-board upgrade sold separately. NetWorth Inc., 8404 Esters Blvd., Irving, TX 75063; 800-544-5255, 214-929-1700; fax, 214-929-1720.*

Circle 958 on reader service card

NEW

Ungermann-Bass Extends VNA with Stackable Hub

Access/Stax, another new stackable 10BaseT hub, is now offered in both managed and unmanaged versions from Ungermann-Bass. This 24-four port, segmentable hub lets you place up to five hubs in a single stack, accommodating three separate networks for a total of 120 ports. The hub is able to participate in Ungermann-Bass' Virtual Network Architecture (VNA), which allows you to assign people to workgroups as the need arises. VNA allows these workgroups to work independently of the network's physical topology.

The integration of NetDirector, Ungermann-Bass's high-performance network platform, distinguishes it from other stackable hubs such as the Series 3000 from NetWorth. NetDirector and support for other Simple Network Management Protocol solutions provide a means for monitoring and managing the stack. Graphics-based management is provided through a Windows-based management system. The hub also includes support for Novell's Hub Management Interface (HMI), Hub Services Manager, and HubCon management utility. Ungermann-Bass' flexible management options allow access/stax to be integrated with other leading network management systems, including Hewlett-Packard's OpenView, IBM's NetView 6000, and Sun's SunNet Manager.

• List price: *Access/Stax 24-port unmanaged hub (AH2400TU), $1,995; Access/Stax 24-port managed hub (AH2400TM), $2,995. Ungermann-Bass Inc., 3900 Freedom Circle, Santa Clara, CA 95054; 800-777-4526, 408-496-0111; fax, 408-970-7386.*

Circle 959 on reader service card

BRIEFS

BACKUP

EMERALD SYSTEMS' upgraded EmSAVE 3.31B ($395) backs up peer-to-peer networks using Microsoft Windows for Workgroups (WFW), whether operating on NetWare or not. The new version provides workgroup users with a SCSI-based backup system. Each WFW user can elicit up to 10MB of data in e-mail and scheduling functions, and an additional 30MB or more in program data. 800-767-2587, 619-673-2161; fax, 619-673-2288.

MOUNTAIN NETWORK SOLUTIONS INC. also offers network backup for SCSI-based systems. The Windows-based FileSafeplus Librarian ($129) includes Mountain Rescue, a disaster recovery utility, and the Restore Any Day (RAD) media-management scheme. Two backups are performed on the network: a complete backup of the hard disk is executed once a week, and a differential backup is performed each day, recording changes since the last complete backup. Mountain Rescue records this information onto a floppy disk, providing full recovery in the event of system failure. 408-379-4300; fax, 408-379-4302.

STORAGE DIMENSIONS increases enterprise-wide network availability by integrating tape drive support for its LANStor Continua RAID disk array and the LANStor ReFlex hot-pluggable modular storage system. Network administrators also experience an increase in backup performance because tape backup units and hard disks are located on the same SCSI bus and are consolidated into one enclosure. The DAT modules are available in 2GB and 4GB capacities for $1,965 and $2,180, respectively. 408-954-0710; fax, 408-944-1200.

Photograph by Tom Upton

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The new workgroup support in Commence 2.0 keeps everyone in your business closely connected, with support for multiple PC environments whether those PCs are connected via a Local Area Network or not. PCs connected by a LAN can share categories of information transparently. The unique Sync Link feature allows for automatic synchronization of databases, even those residing on PCs not linked by a LAN; users with multiple PCs for home, office and travel can easily update all their systems. Even users with dissimilar Commence databases can easily share data and definitions through the new Transfer feature. You also get multi-level data security. Life can be so easy when you have the right connections:

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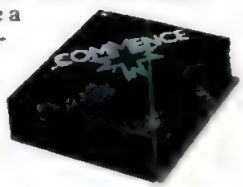

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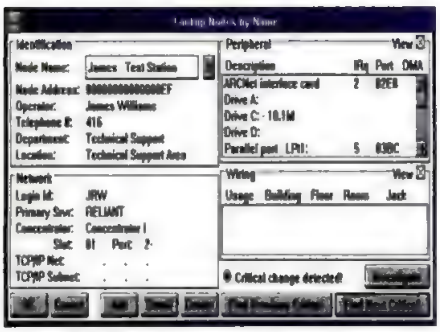
NEW

NodeVision Added to Automatic Design's Net Tools

Automated Design Systems' Net Tools NodeVision helps LAN administrators perform network troubleshooting. This node-focused change management system is transparent to the end user. The addition of NodeVision, formerly offered by Fresh Technology Corp., lets the network administrator monitor and report changes in hardware and software configurations, and concentrate on operational management.



Administrators can locate all critical changes with NodeVision's Find Previous and Find Next Critical commands.

When an end user logs on, NodeVision runs a scan of each network node's hardware and software on the system. It then compares the information to a baseline file and isolates critical changes. The network manager can then identify the conditions causing the changes and save valuable time in correcting the problem. NodeVision also keeps a baseline file to monitor changes in key configuration files, such as the AUTOEXEC.BAT, COMMAND.COM, and CONFIG.SYS files. Other management features check cables and connectors, network concentrator connections, TCP/IP addresses, and uninterruptible power supply (UPS) monitoring. The package isolates unauthorized software version changes, detects viruses, provides a database of problems, and proactively manages nodes.

• List price: *Net Tools NodeVision: 50-node license, $995; 100-node license, $1,895; 300-node license, $3,995; 500-node license, $5,995; 1,000-node license, $9,995. Automated Design Systems Inc., 375 Northridge Rd., #270, Atlanta, GA 30350; 800-366-2552, 404-394-2552; fax, 404-394-2191.*

Circle 960 on reader service card

IMPROVED

SunSoft Integrates Multimedia with Electronic Correspondence

SunSoft now bundles Solaris with a set of multimedia technologies called Solaris LIVE! This multimedia e-mail package combines end-user productivity tools and multimedia application programming interfaces (APIs). It supports video conferencing, audio, and image integration into electronic documents. The result is network-based multimedia.

ToolTalk and a specialized message set called the Media Exchange let the user integrate multimedia into an application. The package also features a set of DeskSet tools, which include AudioTool, ImageTool, and Multimedia MailTool. The desktop version provides a SVR4-based operating system with built-in networking.

Multimedia Mail attaches images, audio, or video files and sends them anywhere on the network. DeskSet's AudioTool provides a GUI for the recording and playback of CD-quality audio. DeskSet's ImageTool uses a GUI to capture, manipulate, and display images.

SunSoft also adds video, graphics, and imaging capabilities to its latest release of Solaris. XIL enables full-motion video, XLib provides graphics support within X Windows, and XGL and PEXlib provide advanced geometry operations.

• List price: *Solaris with Solaris LIVE!, $795. SunSoft Inc., 2550 Garcia Ave., Mountain View, CA 94043; 800-227-9227, 415-336-0678.*

Circle 961 on reader service card

BRIEFS

NETWORK MANAGEMENT

SYMANTEC CORP. announced The Norton Desktop for Windows (NDW) Network Menuing Admin Pack, Version 2.2. This easy-to-use menuing system provides centralized network security and control. Using a hotkey combination to access the password-protected Administrator's Mode, the manager can create menus and applications with standard dialogs in NDW's Quick Access program. It is available for $295 per server and offers support for most major operating systems, including Banyan's VINES. 408-253-9600.

XTREE CO. is shipping XTreeNet, Version 2.5. This upgrade, specifically for NetWare managers, combines the file, directory, and disk management features of XTree Gold with new capabilities such as branch logging and window displays, longer file specifications, and ZIP archiving. The software is available for $495; server extensions cost $295. Registered users of XTreeNet can buy the base package upgrade for $95; the server extension upgrade costs $75. Registered users of other XTree products can upgrade for $249 for the first server and $149 for each server extension. 800-333-6561; fax, 805-541-4762.

TCE TECHNOLOGY CORP.'s BanScan II features a VINES module for added management capabilities. The combination ($749 per server for one to five servers) ensures enterprise-wide management for multiplatform environments. Key features include on-screen resource utilization trending, threshold alarm notification, and the ability to produce custom graphs and file output for reporting. Future modules will include NetWare, SCO Unix, and SNMP. 408-321-7600.

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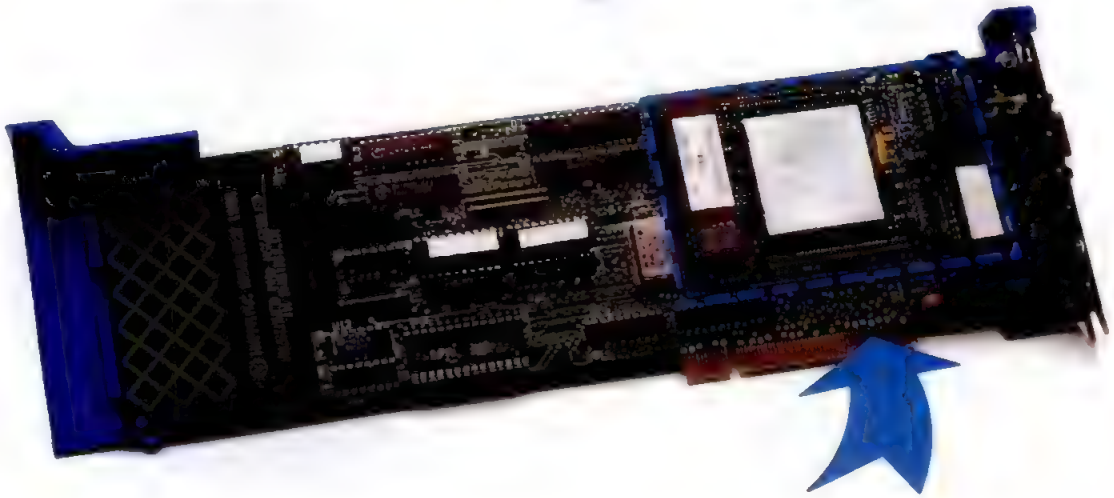

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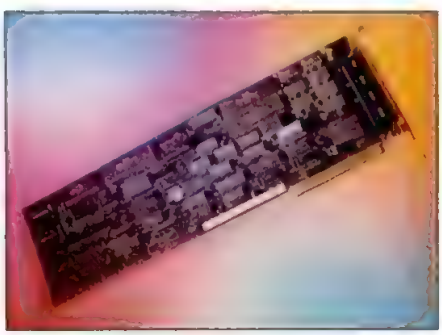
IMPROVED

ACS2 Provides Dial-In Support for Remote Nodes

Network Products Corp.'s ACS2 (Asynchronous Communications Server, Second Generation) provides greater flexibility for its modem-sharing products with the addition of dial-in support for remote nodes. INS (the Inbound Node Support option) supports routing services for up to 32 ports. Support for Novell's IPX/SPX protocol and Novell's NetBIOS have already been included.



ACS2's descriptive naming scheme lets administrators group parts by name and according to function.

This high-speed gateway also provides NCSI (Network Communications Services Interface) support on the outbound, as well as compatibility with Novell's NASI or NACS, and Ungermann-Bass's NETCI. Remote-control and remote-node functions are performed simultaneously.

ACS2 is available in 4-port, 16-port, and 32-port versions. Used in conjunction with the NPCC (Network Products Communication Controller), ACS2 can become a nondedicated communications server with 4 added ports. The 16- and 32-port versions run in a dedicated host PC and require one NPCC for every 4 active ports.

• List price: *ACS2, 4-port version, $495; 16-port version, $1,295; 32-port version, $1,995; INS 16-port version, $1,795; INS 32-port version, $2,695. Network Products Corp., 1440 W. Colorado Blvd., Pasadena, CA 91105; 800-638-7765, 818-441-6504; fax, 818-441-6894.*

Circle 962 on reader service card

IMPROVED

XcelleNet Enhances RemoteWare Family

RemoteWare's AppliComms allow a central site to manage multiple remote locations. XcelleNet's toolset consists of electronic forms, documents, reports, and mail. These enhancements to the RemoteWare family tie customers and suppliers to the system and provide the ability to address wide-area applications.

RemoteWare Forms, Version 1.3, provides workflow automation, allowing an individual to build applications and manage them over hundreds or thousands of locations. Using a hierarchical view, a master record can be created and stored at a central location and distributed electronically to remote users. Designated individuals can dial up and query the database, enter information on the forms, and send the information back to the central location.

RemoteWare Documents, Version 1.2, graphically manages text and graphics information. RemoteWare Reports, Version 1.2, dispatches information electronically in report form to remote sites and mobile users. RemoteWare Mail, Version 1.3, a wide-area messaging system, provides a competitive alternative to Federal Express and faxing. Users can exchange mail with users of popular e-mail services such as MCI, AT&T, or other X.400 systems.

• List price: *RemoteWare Forms, Version 1.3, $7,500; remote nodes, $225 each; Query Server, $4,500. RemoteWare Documents Version 1.2, $2,500; remote nodes, $150 each. RemoteWare Reports, Version 1.2, $1,500; remote nodes, $125 each. RemoteWare Mail, Version 1.3, $3,000; remote nodes, $75 each. XcelleNet Inc., 5 Concourse Pkwy., #200, Atlanta, GA 30328; 404-804-8100; fax, 404-804-8102.*

Circle 963 on reader service card

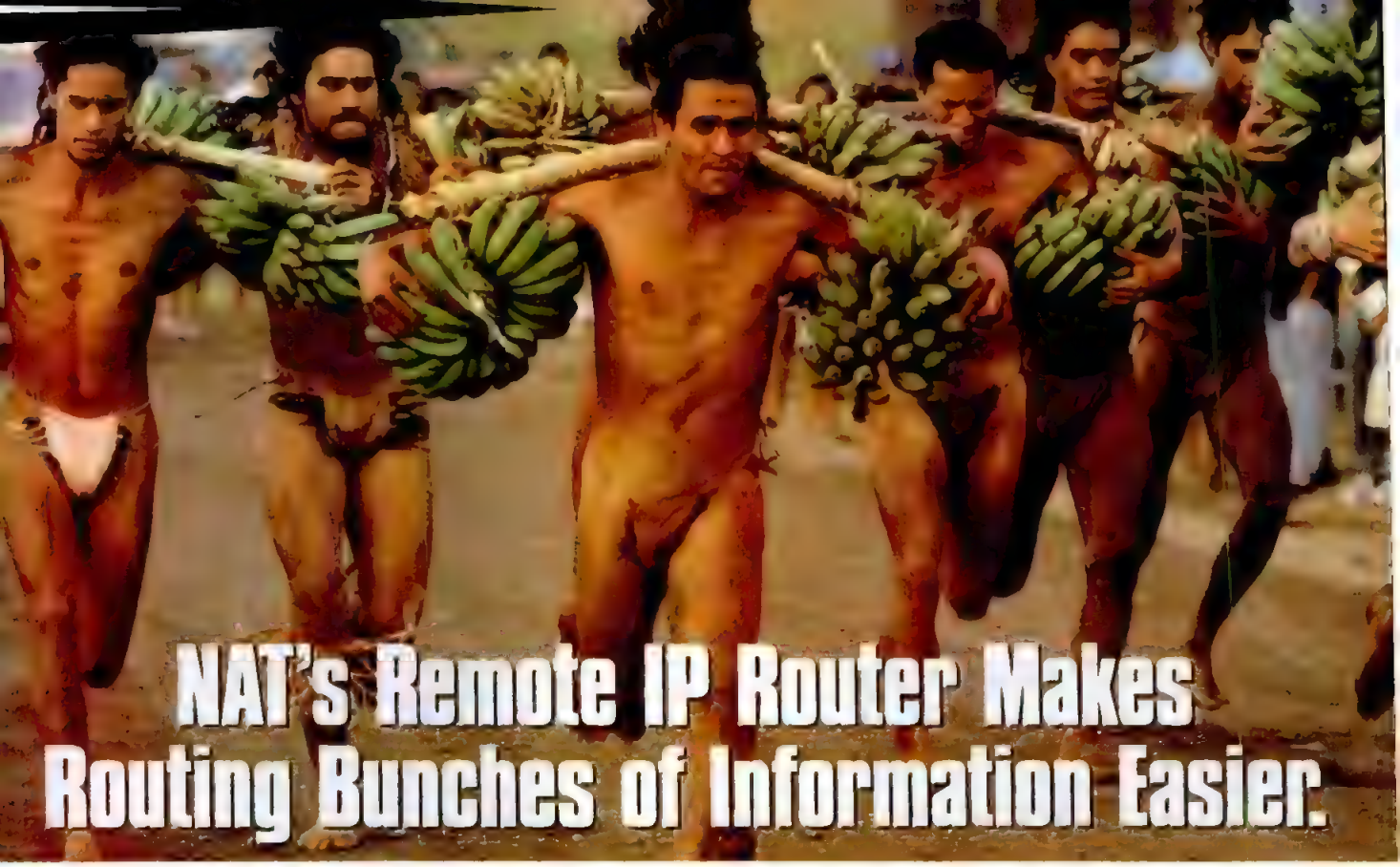
BRIEFS

HUBS

XYPLEX is the first company to deliver increased virtual bandwidth to network managers with its 220 Hub/Router, a new module for the Network 9000 Intra-networking Hub. Combining standards-based routing technology with a 10BaseT concentrator lets managers build an Ethernet subnet in any slot of the hub. The module supports routing of IP, IPX, DECnet, and AppleTalk, with full RIP and OSPF support, and concurrent bridging for all non-routed protocols. It is available for $3,750, and another version, the 221 Hub/Router with port-level security for users on the wiring concentrator, lists for $4,250. 508-264-9900; fax, 508-264-9930.

LANART CORP. offers competitive pricing and performance for up to 48 users of Ethernet local area networks. The 24-port workgroup hub is available in an SNMP version for $1,995 and an RS-232 managed version for $1,495. The companion extension hubs, providing the extra 24 ports, are $1,195 and $995, respectively. The product supports up to 48 PCs, workstations, file servers, and other devices and is specifically designed for 10BaseT networks. 617-444-1994; fax, 617-444-3692.

3COM CORP.'s price reductions make operating a smaller LAN even more affordable. The LinkBuilder FMS TP Hub, the second-generation stackable hub, is now available for $995, down from $1,095. Reducing the ISOVIEW network-management system software to $645, in conjunction with FMS, provides easy-to-use management features previously associated only with high-end chassis hubs. 800-638-3266, 408-764-5000.



NAT's Remote IP Router Makes Routing Bunches of Information Easier.

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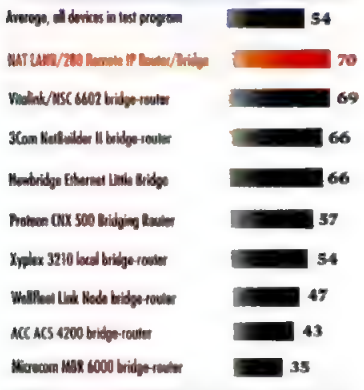

NAT's LANB/290 Remote IP Router/Bridge is the latest revision to NAT's already acclaimed LANB/280 Remote IP Router/Bridge.

NAT's LANB/290 Remote IP Router provides the most affordable high-performance solution for expanding Internet Protocol networks to remote locations. The LANB/290 passes data between networks more efficiently by routing only necessary traffic over the WAN link.

The LANB/290 routes information easily, even in today's multi-vendor enterprise networks. It is compatible with Ethernet routers from other vendors—forwarding non-IP packets using the standards-based Point-to-Point Protocol (PPP).

The NAT router supports the latest SNMP standard, so it's compatible with the most advanced management stations (including NAT's own NMS/100). So, you can maximize the potential of your multi-vendor network.

Great features are meaningless if you can't get the router up and running—that's why NAT designed the LANB/290 to be a true plug-and-play device—so installation and operation won't drive you bananas!

Don't let your network traffic become a spectacle. Beat the competition and pick an NAT router.

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CIRCLE 864 ON READER SERVICE CARD

"Are you ready for this? I stay at work late the other day to change the network interface card on our file server. I want to get it done before morning so no one is inconvenienced. Basically, it's a piece of cake. Until I try to bring the network back up and the server won't attach itself to it. So now 87 PCs are down. Now if I don't get this fixed, these folks will show up for work but won't be able to. So either I solve the problem now or bear the wrath of some important people around here tomorrow.

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Hundreds of people count on him for network support. The question is, who is he counting on?

Given the complexity of today's networks, it's easy to see why multi-vendor technical support isn't just a luxury. It's a necessity.

If, for example, you're responsible for installing, configuring, maintaining, supporting or administering a network in a mixed computing environment, you know how confusing it can be to locate a problem. Let alone find the solution.

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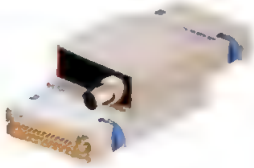

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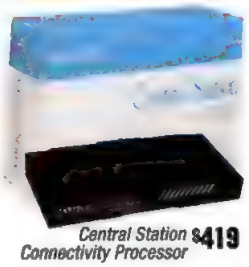

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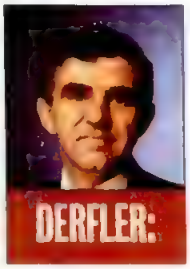
Peer-to-Peer LANs: Friend or Foe?

Dave, my mother always said that if you put good things into the soup it will taste good. Today's networks should be like a good soup, offering something for everybody. I don't like the haute cuisine networking solutions that focus on a single server as the center of all networking. Peer-to-peer networking is home cooking that can satisfy a lot of network hungers.

Novell and Banyan—the main advocates of the server-centric model—hold, to no one's surprise, that security and efficiency demand a dedicated, multitasking, multithreaded server. Novell's propagation of NLMs and System Application Services as the answer to every network need stems mainly from a desire to insure the full employment of white-toqued chefs in fancy networking kitchens whose shelves are lined with red NetWare boxes.



These networking folks have become so accustomed to fancy restaurants and exotic foods that they've forgotten where they originated from. Idle equipment sits heavily on the balance sheet. An office manager can buy a top-notch 486/DX 33MHz machine for $2,000, but what is it going to do? Surely its processor will remain idle 99 percent of the time. Sharing files, printers, modems, CD-ROM drives, and WAN connections through desktop PCs connected in a peer-to-peer network makes much better economic and operational sense than server-centric computing.

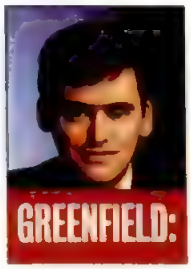
Peer-to-peer networking makes much better economic and operational sense than server-centric computing.

Dave, you've roasted me for my support of Microsoft's Windows for Workgroups. But I still believe that Windows for Workgroups will be the bread in the Windows NT sandwich. Users can connect a workgroups with peer-to-peer LANs and when they need to run client-server applications they can add a system running NT, a powerful 32-bit operating system to their network.

A peer-to-peer LAN teaches you that the server isn't the only resource on your plate. You don't have to give up your peer-to-peer network to sample server-based networking. If you only need the horsepower of a dedicated server, all of the leading peer-to-peer products—including LANtastic, POWERLan, and Windows for Workgroups—provide easy access to network resources. Peer-to-peer networking fills the void for hard-working folks without emptying their wallets and that is the best recipe yet.

Frank, peer-to-peer LANs aren't the answer to some mysterious plot by Novell and Banyan to control customer accounts. The issue of peer-to-peer LANs is about the very real and practical issue of network management.

Users love the idea of peer-to-peer LANs. They're comparatively inexpensive, easy to install, and offer most of the functionality that they need. Need a file from John's machine? No sweat. Just log in, and pull the file off his machine yourself. Need to share printers? Simple. Attach a printer to your machine and presto! You've got a networked printer.



However, this model of simplicity quickly disintegrates in real-life circumstances. Tell me, Frank, when a cable gets cut, are users going to fix the problem themselves? When a user's disk fails, who will provide a temporary machine? Or when that printer can no longer be shared, who is going to figure out why?

Once you reach a critical number of computers, you need a networking specialist to manage and troubleshoot the network.

The answer is clear. Once you reach a critical number of computers, you need a networking specialist to manage the LAN.

And that LAN specialist must make sure the data on the network is sufficiently protected, that consistent backups are made, and that network information can be gathered and tracked for bill-back and other auditing purposes.

Right now, such capabilities demand centralized servers. Peer-to-peer LANs are just beginning to acquire the management tools to monitor and control a large network. But there's still a long way to go. Most peer-to-peer LANs still require you to log into each network device. This is impractical, even on a medium-sized network with a half-dozen printers.

Also, most peer-to-peer LANs don't support a high-performance file system, which is essential for mission-critical applications. With the advent of Windows NT and OS/2 2.1, and with renewed interest in Unix and the other 32-bit operating systems, this situation will change. But until that time, client-server applications can only be effectively supported on server-centric network operating systems.

For now, business will stick with server-centric operating systems. Should peer-to-peer LANs catch on, particularly where LANs already exist, it would signify an emerging discontent with network managers. And that, Frank, isn't a function of a demonic plot by networking providers, but an issue of user support.

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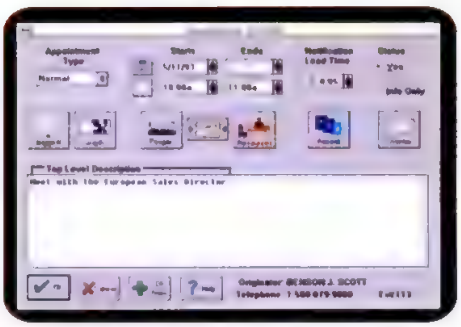
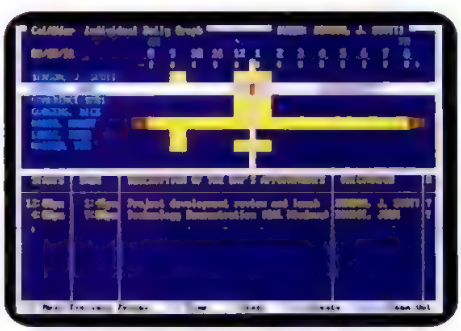


The CaLANdar for Windows Create/Modify screen provides access to people and resource lists, the appointment date/time suggestion facility, the graphical group availability screen and much more.



The CaLANdar for DOS "zoomed" group graph provides a graphical overview of each of the selected people and/or resources.

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Overwriting Deleted Files

Changing EDIT's File Type

BY NEIL J. RUBENKING

OVERWRITING DELETED FILES

The batch file WIPEDEL.BAT shown in Figure 1 overwrites the disk space of deleted files. It starts with a 10-byte file and repeatedly creates new files ten times as large—up to 1,000,000,000 bytes—using the DOS COPY command.

Why should you use this batch file? You may not realize it, but after you delete a file, chances are good that its data is still present on your hard disk. Until the data gets overwritten by another file, it's possible to recover the entire file you deleted. Sometimes this is very useful, as when you delete a file by mistake. But if you want to really eliminate a file containing sensitive information, you have to make sure the disk space that was occupied by that file gets overwritten with new data.

There is sophisticated software available that does this very well, but sometimes you don't need all that sophistication to take care of a simple problem.

Tommaso De Francesco
Mozzagrogna, Italy

▶PC MAGAZINE: I took a few liberties with the WIPEDEL.BAT program, making it more compact and foolproof. To run the program, just pass it the letter of the drive whose unused space you want to overwrite, without the colon. There is no second parameter, so the IF test in the first line is false. The batch file checks to make sure it won't overwrite any files, then jumps to the label Ready. The ECHO line just after this label creates the initial 10-byte file (eight X characters plus carriage return and line feed make 10 bytes). You can replace the XXXXXXXX with any eight characters you like. I chose the bizarre file extension ≤∞≥ in order to minimize the chance of matching existing file names.

Next the batch file checks that there's enough environment space to create variables WipeDelP and WN. WipeDelP holds the number of the previous WIPEDEL data file, initially 1, while WN contains the full pathname of that data file. If there's enough environment space, WIPEDEL.BAT calls itself eight times, passing the original first parameter and a number from 2 through 9.

This time, WIPEDEL has two param-

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WIPEDEL.BAT

Complete Listing

```
@ECHO OFF
IF NOT '%2'=='' GOTO NotFirst
IF NOT EXIST %1:\NUL GOTO Syntax
ECHO Now overwriting data belonging to deleted files.
REM "degree" symbol in next line is ASCII character 248.
REM File extension is ASCII characters 243, 236, and 242.
IF NOT EXIST %1:\°?.≤∞≥ GOTO Ready
ECHO Files matching °?.≤∞≥ exist in the directory %1:\
ECHO Delete or move these files before running %0.
GOTO Done

:==== Ready ========
ECHO XXXXXXXX> %1:\°1.≤∞≥
SET WipeDelP=1
IF NOT '%WipeDelP%'=='1' GOTO ShortEnv
SET WN=%1:\°%WipeDelP%.≤∞≥
IF NOT '%WN%'=='%1:\°%WipeDelP%.≤∞≥' GOTO ShortEnv
FOR %%v IN (2 3 4 5 6 7 8 9) DO CALL %0 %1 %%v
GOTO CleanUp

:===== NotFirst ====
SET WN=%1:\°%WipeDelP%.≤∞≥
IF NOT EXIST %WN% GOTO Done
ECHO Creating %1:\°%2.≤∞≥ from ten copies of %WN%
COPY /B %WN%+%WN%+%WN%+%WN%+%WN%+%WN%+%WN%+%WN%+%WN%+%WN% %1:
\°%2.≤∞≥ > NUL
SET WipeDelP=%2
GOTO Done

:==== Cleanup =====
DEL %1:\°?.≤∞≥
ECHO Unused areas of %1: have beep wiped.
SET WipeDelP=
SET WN=
GOTO Done

:==== ShortEnv ====ECHO %
0 requires approximately 32 bytes of environment space.
ECHO Not enough environment space to run %0.
GOTO Done

:==== Syntax ======
ECHO SYNTAX: %0 d
ECHO   where d is the drive letter without colon
:==== Done ========
```

Figure 1: **WIPEDEL.BAT overwrites all unused space on a drive, thus preventing undeletion of sensitive file data that has been deleted.**

eters, so the initial IF test jumps to the label NotFirst. Here the batch file sets the variable WN to the name of the previous WIPEDEL data file and concatenates ten copies of that file to form the new WIPEDEL data file. The number for the new data file comes from the second parameter. Before quitting, it updates the WipeDelP variable for the next repetition. Each time around, these batch lines create a data file ten times as large as the previous one, until no disk space remains.

After overwriting all the unused disk space, WIPEDEL.BAT jumps to the label Cleanup. Here it deletes the data files and clears the environment variables. You probably won't use WIPEDEL often, but when you need to wipe out sensitive data it will save your bacon! Be prepared to take a coffee break, though. DOS's COPY command isn't very fast.

WIPEDEL.BAT can be downloaded from the Utilities/Tips Forum on PC MagNet as WIPEDE.BAT.

CHANGING EDIT'S DEFAULT FILE TYPE

Whenever I tried to open an existing file from within the DOS 5.0 editor, I found I had to change the default *.TXT to the filename I wanted to open. But, as it turns out, it's very easy to modify the default.

First save the file QBASIC.EXE to another name, just in case. Using your favorite hex editor (I use the one in PC Tools), open the QBASIC.EXE file, search for the hex string 54 58 54 (TXT) and change it to 2A 00 00 (* followed by two null characters).

The next time you open an existing file in EDIT, you'll see *.* in the File Name box, and all files in the selected directory will be shown in the Files list below. Now you can just cursor to the file you want and press Enter.

Brian Sisk
Toney, Alabama

▶PC MAGAZINE: It may seem odd that you patch QBASIC.EXE to change the behavior of EDIT.COM, but in fact it's perfectly reasonable. EDIT.COM executes QBASIC.EXE, passing it the command line switch /EDCOM followed by the filename to edit, if specified. The default file specification *.TXT appears in QBASIC.EXE, not in EDIT.COM.

Not everyone has a fancy hex editor like the one in PC Tools, but we do have DEBUG. If you're willing to follow some detailed instructions, you can use DEBUG to apply this patch to QBASIC.EXE in DOS 5.0 or 6.0. First copy QBASIC.EXE to QBASIC.X, since DEBUG won't let you patch .EXE files directly. Then give the command `DEBUG QBASIC.X` to load the copy into DEBUG.

At DEBUG's dash prompt, enter the `R` command to list the values of the CPU registers (Figure 2 shows an example). The BX and CX registers hold the size of the QBASIC.X file: BX is the number of complete 64K segments and CX is the size of the final partial segment.

DEBUG always loads files at an offset of 100h bytes into the segment defined by the CS register. To get the starting segment address for the search, use the `H` command to add 10 to the value of the CS register. In this case, use

```
H 2D8F 10
```

DEBUG returns two values, the first of which is the starting segment. Write down this value, along with the starting values of BX and CX.

DEBUG can only search 64K of memory at a time and QBASIC.EXE is many times that large, so you may have to repeat the search several times. Start with the command

```
S 2D9F:0 L 0 '*.TXT'
```

replacing 2D9F with the starting segment you calculated. If DEBUG simply returns to the dash prompt without displaying an address, subtract 1 from the BX value you noted and repeat the command, adding 1 to the first digit of the starting address. The easiest way to repeat the command is to press the right arrow twice, type the new first digit, and press F3—the standard command line editing keystrokes work in DEBUG too!

Repeat this process until DEBUG responds with an address or until you reduce BX's value to 0. When that value is 0, you've encountered the final partial segment of the file. For this last search, increase the first digit of the starting segment as before, but replace the 0 that follows the letter L in the command with the original value of the CX register. If the search command doesn't return an address even on this final command, it's possible your copy of QBASIC.EXE has already been patched. Figure 2 shows the result of a successful search for the string *.TXT.

The result of this massive search is the address of the string *.TXT—in this case, 5D9F:CBFA. To change that string to *.*, use the command

```
E 5D9F:CBFA '*.*' 0 0
```

replacing the address 5D9F:CBFA with the address you found. Enter the commands `W` for Write and `Q` for Quit to complete the job. Move the original QBASIC.EXE to a floppy disk or archive directory, then rename QBASIC.X to QBASIC.EXE. From now on, when you give the EDIT command, the default filespec will be *.*. □

SCREEN DUMP

```
C:\DOS>DEBUG QBASIC.X
-R
AX=0000 BX=0003 CX=E8D9 DX=0000 SP=FFEE BP=0000 SI=0000 DI=0000
DS=2D8F ES=2D8F SS=2D8F CS=2D8F IP=0100  NV UP EI PL NZ NA PO NC
2D8F:0100 4D      DEC   BP
-H 2D8F 10
2D9F 2D7F
-S 2D9F:0 L 0 '*.TXT'
-S 3D9F:0 L 0 '*.TXT'
-S 4D9F:0 L 0 '*.TXT'
-S 5D9F:0 L E8D9 '*.TXT'
5D9F:CBFA
-
```

Figure 2: **Your search for the string *.TXT in QBASIC.EXE will look like this, but the addresses will be different.**

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Your friends at Stac

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TUTOR

Why You Should Defragment Your Disk

BY JEFF PROSISE

One of the beauties of the FAT file system, which DOS uses to keep track of where files are stored on a disk, is that files don't have to be stored in contiguous clusters. If DOS needs 100K of disk space to store a 100K file, it can store it in, for example, one 100K block, five blocks of 20K each, or even in 50 blocks of 2K each on a drive with 2K clusters. None of these clusters have to be adjacent to one another; one could lie on the outermost cylinder of the disk, and another could lie near the disk's center. This is important, because if files had to be stored in contiguous clusters, DOS would constantly have to rearrange clusters containing file data to make room for new or lengthened files. File operations would slow to a crawl.

DOS views a disk as a large array of allocation units, or clusters, with each cluster comprising one or more sectors of disk space. The file allocation table, or FAT, is like a road map to the clusters. Each entry in the FAT corresponds to one cluster on the disk. A FAT entry whose value is zero indicates that its corresponding cluster is unused. If a FAT entry contains a nonzero value, then the corresponding cluster is either in use by a file or reserved for other reasons.

The clusters that hold a file's data are linked by way of their FAT entries. The FAT entry for the first cluster contains the *number* of the second cluster, the FAT entry for the second cluster contains the number of the third cluster, and so on. The *last* FAT entry contains a special value that indicates it's the last.

The value FFFF hex (or FFFh in 12-bit FATs) marks the end of an allocation chain, and the file's starting cluster number is recorded in the 32-byte directory entry that holds the filename and other information about the file. A file that requires several clusters of storage space can be spread about a disk as needed to make efficient use of storage space. The clusters the file is stored in need not be adjacent to one another. A complete record of each cluster that contains a piece of the file is recorded in the FAT.

Figure 1 shows the chain of FAT entries DOS sets up for a file whose ten clusters are divided among three regions of the disk—clusters 10h and 11h, 16h through 19h, and 1Eh through 21h. The file's directory entry holds the starting cluster number (10h). FAT entry number 10h contains the value 11h, which identifies the next cluster in the allocation chain. FAT entry 11h contains 16h, FAT entry 16h contains 17h, and so on. The allocation chain terminates in cluster number 21h, whose FAT entry is equal to FFFFh.

How do hard disks become fragmented? This issue's Tutor column explains fragmentation, how it degrades your disk performance, and how you can remedy this situation.

When DOS searches for free clusters in which to store file data, it searches from lower cluster numbers to higher cluster numbers and allocates them in the order that it finds them. Therefore when a disk is brand new, most of the files you write to it are stored in contiguous clusters, because the disk contains mostly contiguous free space. Once you start deleting files, however, new files saved to the disk may become fragmented. If a new, large file uses the clusters previously occupied by a small deleted file, the new file will be fragmented; since the large file can't fit in the same number of clusters as the small one, it will have to find and store its data in additional clusters, which may not be contiguous.

A natural consequence of the method that DOS uses for allocating space on a disk is that file fragmentation increases over time. And as fragmentation increases, it takes longer to read and write files. Drive heads have to move more when reading and writing fragmented files, since these files are stored in noncontiguous clusters that can be located anywhere on a disk. The more a drive head has to move to find the next cluster, the longer it's going to take to read and write a file. You may not notice the speed degradation, because it occurs slowly. But it's there, and if you don't defragment the files on your hard disk from time to time, you'll soon notice that it's taking longer and longer to read and write files.

DEFRAGGERS: RX FOR FRAGMENTED FILES

You can combat file fragmentation with a defragmenting utility. Defragmenting programs, also referred to as *defraggers* and *disk optimizers*, rearrange the files on a disk so that each file is stored in contiguous clusters. Figure 2 illustrates the effect that defragging has on a fragmented disk.

The diagram on the left shows the allocation chain for three fragmented files before defragging. Each block in the diagram represents one FAT entry, and therefore one cluster of disk space. Arrows trace the allocation chains. On the right, the diagram shows the same allocation chains after a defragger is run. Each

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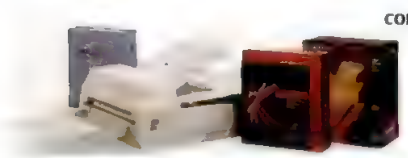

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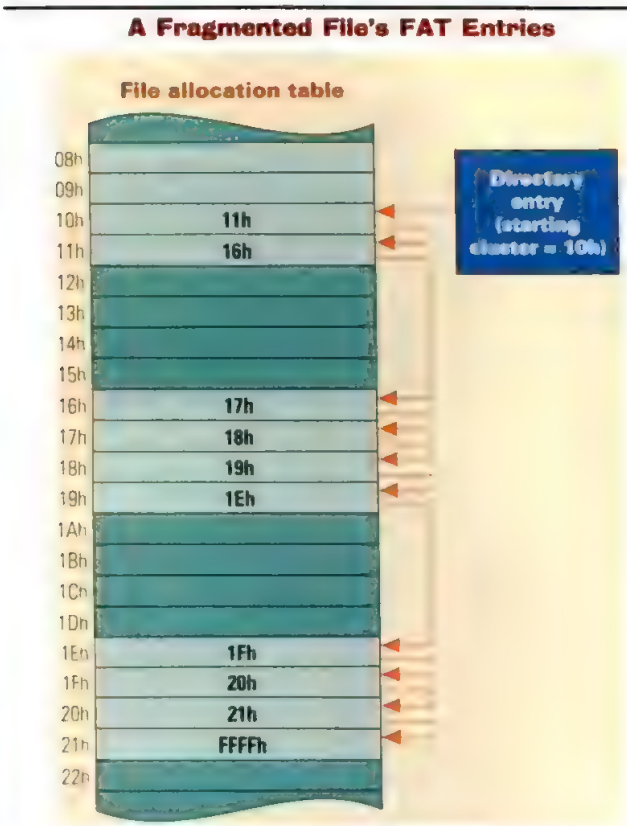

Figure 1: **This file's ten clusters are stored in three noncontiguous areas of the disk. Each FAT entry identifies the next cluster in the allocation chain.**

of the three files is now stored in contiguous clusters, minimizing the distance the drive heads must travel to read or write a file from beginning to end.

This example is somewhat simplistic, because most defraggers will perform other tasks, too. For example, a defragmenting program might offer to sort the file and subdirectory names for you as it shuffles files around on the disk, and it might include an option for moving subdirectory entries as close as possible to the front of the disk so that DOS can locate files in remote subdirectories more quickly. But the essence of defragging is to restore order to files by storing them in contiguous clusters, and Figure 2 illustrates this graphically.

The good news is that you don't have to pay a single dime to arm yourself with a top-notch defragger. If you bought DOS 6.0, you already have a defragging utility: DOS's DEFRAG program. If you don't have DOS 6.0 and don't have a third-party defragger, you can use Bob Flanders and Michael Holmes's DEFRAGR, which was presented in the February 23, 1993, Utilities column. You can download a copy of DEFRAGR from PC MagNet's Utilities/Tips forum archived as DEFRAG.ZIP. For instructions, see the sidebar "PC MagNet: Utilities and More" in this issue's Utilities column.

Before you run a defragger, it's wise to remove memory-resident programs and unnecessary device drivers from memory. DOS's FASTOPEN is especially dangerous in the presence of defraggers, because FASTOPEN caches the physical location of recently opened files. The problem is that a defragger may change a file's physical location. FASTOPEN, unaware of the defragger's actions, will still think the file is in its previous location. The next time a program reads or writes that file, DOS may return bogus data or, worse yet, copy data to the wrong file.

If you're running DOS 6.0, you can easily boot without loading potentially harmful TSRs by pressing the F5 key when you see the "Starting MS-DOS. . ." message.

THE DEFRAG UTILITY The DEFRAG utility supplied with DOS 6.0 (shown in Figure 3) is a modified version of The Norton Utilities Speed Disk. Starting it is easy: Just type DEFRAG at the command prompt. DEFRAG will ask you to choose the letter of the drive you wish to defragment. Then it will scan the disk and recommend either a *full optimization* or a *files-only optimization*. You can accept DEFRAG's recommendation or change the optimization method through the pull-down Optimization menu.

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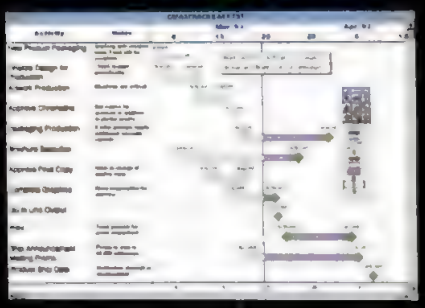

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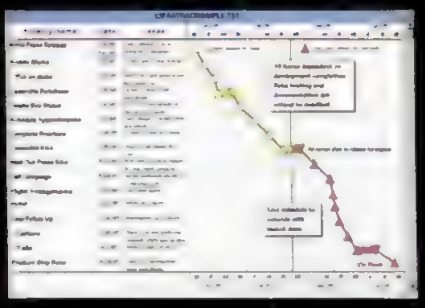

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A files-only optimization rearranges the files on a disk so that each is stored in contiguous clusters. It does not, however, consolidate clusters containing file data in one area of the disk. DEFRAG's cluster map will still show free clusters interspersed among clusters containing files after a files-only optimization is complete. Full optimization restores all files to contiguous clusters *and* packs used clusters together at the front of the disk.

The cluster map for a fully optimized disk will not show free clusters mixed with used clusters. Full optimization also moves subdirectories to the front of the disk (to lower-numbered clusters) in order to speed accesses to files in other directories. A fully optimized disk will run slightly faster, but a files-only optimization requires less time. If you're unsure which you should choose, accept DEFRAG's recommendation, which is based on how severely the drive is fragmented.

Defragging can take anywhere from a few minutes to a few hours, depending on which optimization method you choose, the size and speed of the disk, how many files it contains, and how severely the files are fragmented. If you perform a full optimization on a large hard disk that has never been defragmented before, plan for your PC to be unavailable for quite a while.

If you wish, DEFRAG will also sort filenames and subdirectory names for you—by name, extension, date and time, or size, in descending or ascending order. This sorting doesn't affect a file's physical location on-disk; however it does affect the ordering of the 32-byte directory entries within each directory. Sorting doesn't really make the disk work any faster, but the process does add order to raw directory listings which are displayed by programs that don't sort filenames on their own.

Figure 3: **DOS's DEFRAG program shows a map of a disk's cluster use. In this case, the disk is heavily fragmented.**

DEFRAGMENTING DOUBLESPACE DRIVES

One thing that sets DEFRAG apart from third-party defraggers is that when it defrags a DoubleSpace drive (a drive compressed with DOS 6.0's built-in disk compression program), DEFRAG performs an extra bit of fine-tuning that's only applicable to DoubleSpace drives. Third-party defraggers won't harm DoubleSpace disks, but until they're upgraded to be DoubleSpace-aware, they also won't optimize DoubleSpace disks as completely as DEFRAG will.

If you prefer to use a third-party defragger in place of DEFRAG, you can achieve the same effect that DEFRAG achieves on a compressed drive by manually compacting the sector heap *after* the defragging process is complete. (DoubleSpace allocates disk space by the sector. The *sector heap* is simply the array of clusters on a disk that DoubleSpace is managing. It includes used as well as unused sectors.) To do so, start DoubleSpace and call up the Defragment option in the Tools menu. Or do the same thing from the command line by typing

```
DBLSPACE /DEFRAGMENT d:
```

where *d:* is the letter of the compressed drive. Don't be misled: DoubleSpace doesn't actually defragment the compressed drive as these commands imply. It simply consolidates free space in the sector heap. It's likely that third-party defraggers will be available soon (they may already be available when you read this) that fully defragment DoubleSpace drives, right down to the sector heap. □

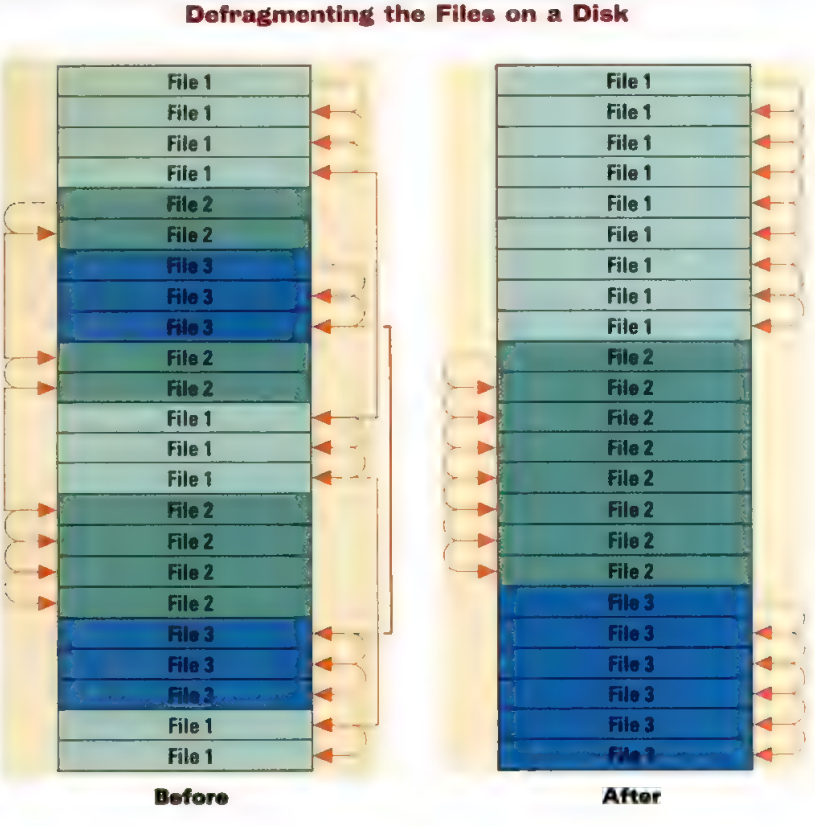

Figure 2: **The diagram on the left shows the allocation chains for three fragmented files before defragging. The diagram on the right shows how a defragger rearranges the pieces so that the files are stored in contiguous clusters.**

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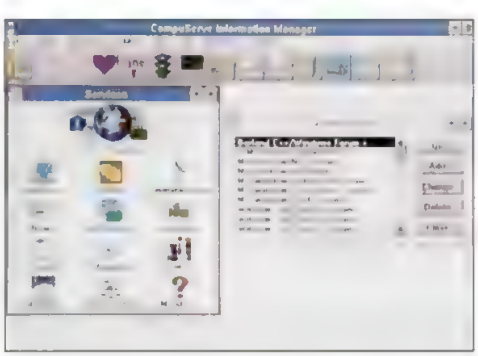

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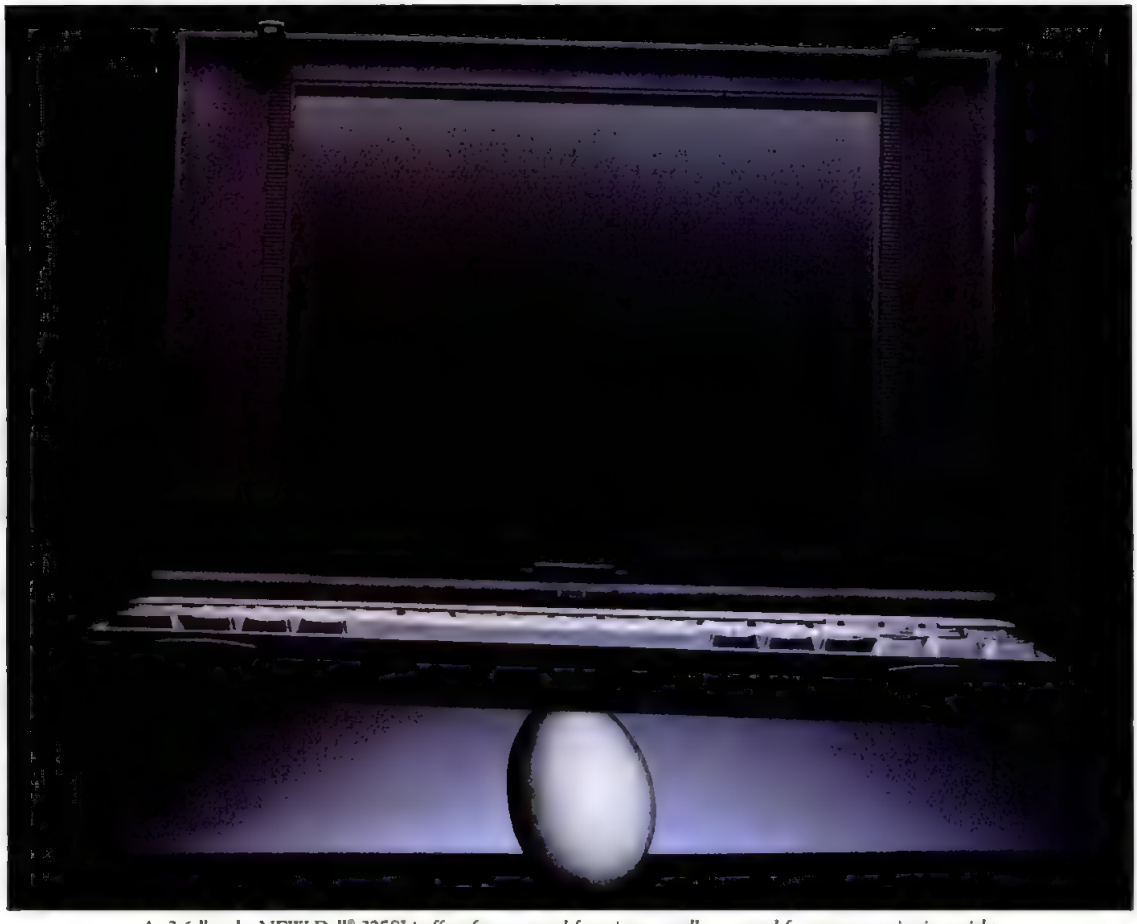

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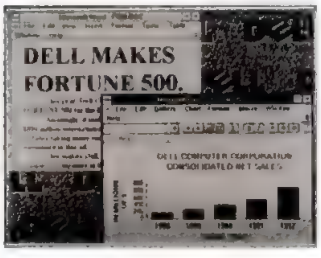

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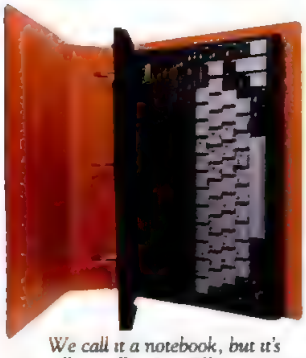

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How Lossy Compression Shrinks Image Files

BY BARRY SIMON

If a picture is worth 1,000 words, it should take up only about 5K of space on your disk. Instead, if you want to draw a 24-bit, 1,024-by-768 color screen it requires about 2.25MB—the equivalent of about 450,000 words. Add motion and the storage requirements become astronomical: a CD-ROM disk holds about 700MB of data, yet it can accommodate only 10 seconds of a high-resolution 24-bit color video.

Getting computers to display photographic-quality images was a tremendous and relatively recent achievement. Developing the highly efficient compression systems needed to store those images was no less of an accomplishment.

In part one of this two-part series, we examined the compression techniques used by such utilities as PKZIP and Stacker. These methods are referred to as *lossless*, since the compressed file is restored as an exact replica of the original file. No loss of information is tolerable with executable files or most data files. In this installment we turn our attention to the special requirements of image compression. While PKZIP can typically reduce a text file to about a third of its original size (a factor of 3), the techniques we'll consider here can compact image files, which are much larger, by factors of 50 or more.

The only way to achieve a reduction of this magnitude is to use what are called *lossy* compression techniques. Such methods intentionally throw away part of the data! As a result, a decompressed image file will not be identical to its original, though the differences will be subtle enough to be undetectable. You won't notice if a few colors are changed by a shade or two out of 16 million, so in an image file not every byte is precious.

SLOW IN, FAST OUT Compression techniques always involve two parts: compression and decompression. There is a trade-off between the time it takes to compress a file and how much compression is achieved. Lossy compression schemes, which reduce large image files to a small fraction of their original size, can take a very long time to execute; an overnight run is not uncommon. But long compression times are not the sole province of lossy algorithms. Special-purpose lossless compression schemes for drastically reducing very large files such as dictionaries will also require hours to run.

Image files have different compression requirements than ASCII or data files. Here's an introduction to three of the most successful systems.

Time-consuming compression programs are not usually distributed as end-user applications; they are used to prepare software for distribution. But since the software must decompress files as it executes, decompression must be speedy.

In this article I'll discuss three image-compression methods: JPEG (Joint Photographic Experts Group), Recursive Vector Quantization (RVQ), and fractal compression.

The "Joint" in JPEG reflects the fact that the specification is a product of two international standards groups: CCITT and ISO. JPEG compression is often incorporated into end-user applications such as image editors, because its compression methods are relatively fast. On the other hand, JPEG-compacted image files are larger for a given quality level than files compressed by other methods. (The quality level is adjustable through parameters; the higher the compression factor, the lower the image's quality.)

RVQ is a one of several methods developed by Knowledge Adventure for use in that company's interactive educational products. It is described here in print for the first time. Compression using RVQ demands a huge amount of computation, and it also requires that some subjective judgments be made at each step of the process. But although the compression process is slow and arduous, decompression is speedy.

Fractal compression is a proprietary method of Iterated Systems. Since the image is stored as a set of formulas rather than as a set of points (or some transformation of a set of points), fractal compression is resolution-independent. The appearance of the image upon decompression depends on the output device; for example, a different set of points will be generated for display on a screen versus a printer. The mathematics that underlie fractal compression are especially complex, but as with JPEG and RVQ, decompression is straightforward and quick.

IT ALL DEPENDS ON THE FILE Compression algorithms for lossless compression can be independent of the structure of a particular file. But lossy compression methods must analyze the structure of the files they are compressing in order to decide what information to discard. An admittedly crude illustration will make this clear.

Suppose you decided to implement lossy compression by simply discarding every other column of an image. The first thing you'd have to think about is how

columns are represented in a file. In a black-and-white image, a column is 1 bit wide, so your algorithm would consist of tossing out every other bit. But in a 24-bit color image, a column is 24 bits wide, so your algorithm would toss out every other 24-bit string.

If you used the algorithm meant for 24-bit color pictures on a black-and-white image, you'd end up throwing away 24-column bands, which would make for a decompressed file of an unacceptably poor quality. If you used the algorithm for black-and-white pictures on a 24-bit color image, you'd end up removing half the bits that describe each pixel's color, producing bizarre color changes. Thus, while the idea of discarding every other column is the same in both cases, the implementation depends on the structure of the file. (The same general principles also apply to sound-compression systems.)

Image-compression methods generally start by breaking the image into nonoverlapping sections of pixels, which can be likened to tiles in a mosaic. The tiles might be 8 by 8 pixels (64) or 16 by 16 pixels (256) in size, for example. If the image is black and white, each pixel will be represented by a single bit. If the image is 24-bit color, each pixel will be represented by 24 bits. Thus, an uncompressed 8- by 8-pixel tile of a 24-bit color image is described by 1,536 bits (192 bytes) of information (8 by 8 by 24 pixels). Compression techniques let you describe each tile with fewer bits.

JPEG: THE SMOOTHING METHOD JPEG compression starts by applying a numeric transformation to the original pixel data in each tile. The transformation used is a special case of the Fourier transform, called the Discrete Cosine Transform (DCT). The DCT lets you describe each tile in terms of *frequencies* and *amplitudes,* rather than pixels and colors. The frequency value describes how rapid the color shifts are; the amplitude value describes the magnitude of the color change associated with each shift.

An 8- by 8-pixel tile has 64 frequencies associated with it. These frequencies are fixed by block size and are independent of the image. For each of the 64 frequencies, there is an associated amplitude. The amplitude values depend on the picture. The 64-pixel color values are transformed into 64 amplitudes, but the amplitudes do not directly correspond to the pixels.

Once the pixels' values have been transformed, the next step is to replace the many different amplitude values with a smaller number of them. This is done through *quantization,* where the amplitudes are grouped together into bins or ranges of values. For example, all amplitudes between -1 and +1 might be grouped together in a single bin. Then each original amplitude is replaced by the middle value of the bin in which it falls; in this example, the middle value is 0. Quantization is the lossy step. The larger the bin, the greater the data loss.

In most images, high frequencies tend to have low amplitudes—that is, when there are rapid shifts in color, the color changes tend to be subtle rather than dramatic. Since the eye can't really see these changes anyway, high-frequency values can be thrown away at a relatively low cost to image quality. So the size of the bins that are used in the quantization process is not uniform: Larger bins are used for the amplitudes associated with high frequencies.

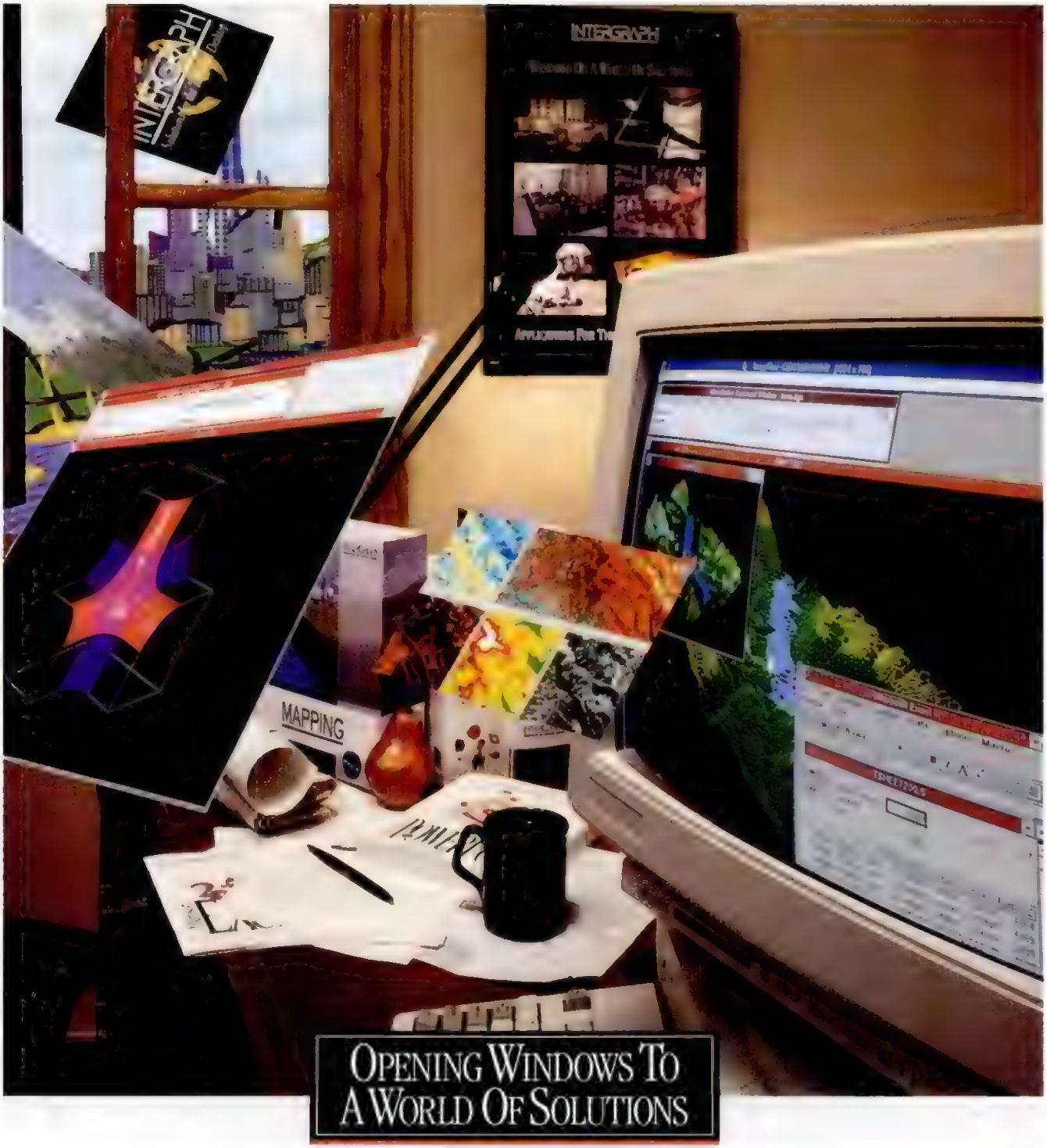
After quantization, the next step in JPEG compression is to use lossless methods to reduce the size of the data stream of binned values. Since small amplitudes are placed in a bin centered around 0, 0 occurs with great frequency in the data stream. Repeated 0 values are compressed using run length encoding (RLE). Other bin values are compressed with Huffman or arithmetic encoding, as described in the Lab Notes column of June 29, 1993.

When using RLE, the way you traverse the picture is important. Simply following scan order, as shown in Figure 1, is not a good idea, since the end of one row and the beginning of the next are not physically next to each other in the image. The JPEG committee therefore chose a method called zigzag ordering, which is shown in Figure 2. Even this method has its faults, however, because it considers the closeness of pixels only in one direction. Many experts feel that ordering in terms of the Hilbert curve, shown in Figure 3, would have been a better choice, as it considers closeness in many different directions.

Visually, the quantization in JPEG compression produces a smoothing of the image. Gradual shading changes are more regular than in the original, but this is virtually undetectable to the eye. This same smoothing can cause sharp edges within an image to be lost, however. If you use JPEG compression on an image of grass, for example, the decompressed image may be blurry and lacking in detail. Moreover, an artifact of the transformation is that, because of inappropriate smoothing, you may see rings of color where sharp edges occur. This is especially true if the binning is too coarse during the compression run.

On the plus side, JPEG compression

Figure 1: **The disadvantage of scan row order for RLE is the discontinuity as you move from the end of one row to the beginning of the next.**



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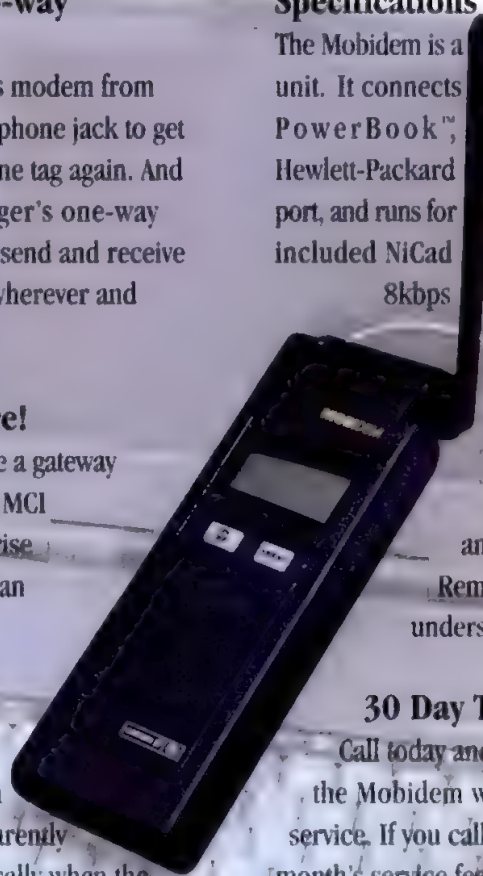

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is very fast—as fast as the decompression of the image. This makes it a practical solution for use in high-end image editors, which need to do image compression in real time.

RVQ: SUCCESSIVE APPROXIMATION RVQ also uses quantization to determine what part of the image to throw away, but different information is quantized. With RVQ, the tiles themselves are quantized.

If you have a 256-color image broken down into 8- by 8-pixel tiles, the number of possible pixel patterns for each tile is enormous; 256 possibilities for each of 64 pixels translates to 256^{64} possible tile patterns. If you are compressing a 24-bit color image (16 million possible colors), the number of possibilities is astronomical. The main idea behind RVQ compression is to reduce the number of possible tile patterns.

A 640-by-480 image broken into 16- by 16-pixel tiles will contain a total of 1,200 tiles. For RVQ compression, you want to replace every one of the 1,200 tiles with one chosen from a much smaller set of reference tiles; for this example, we'll choose 16 reference tiles. In effect, the 1,200 tiles are divided into 16 bins, where the tiles in each bin are as similar as possible. The reference tile for the bin is a kind of average or center. In the quantization step, each of the 1,200 original tiles is replaced with the reference tile for its bin.

How do you find the 16 reference tiles? This is the hard part of RVQ compression. Even when using the most advanced techniques, determining the best set of pixel patterns requires a huge number of calculations and takes a very long time. And when you finally come up with the reference tiles and put them together, you'll discover that the approximation in this first iteration isn't actually very good!

The next step, then, is to XOR (exclusive OR) the approximation you've just created with the original image. To XOR two images, you superimpose one on top of the other. Where the bits are the same you place a 0 bit, and where they're different you put a 1 bit. If you XOR an image with itself, you will get all 0's—a blank, black screen. Any differences between the images will show up as nonblack areas. The nonblack areas can be thought of as a subtraction—the difference between the original image and your approximation.

You then repeat the process on the difference image, finding the best set of reference tiles to represent it. For our example, we'll again choose 16 reference tiles, but we could choose a different number of reference tiles for the second iteration. In RVQ processing, the number of tiles to be used is determined by a subjective decision about how good the compressed image looks.

When you've completed the second-stage approximation, you then XOR the result with the first approximation. (It is a remarkable fact about bit operations that to undo an XOR, you XOR a second time.) You'll find that this second stage image is much closer to the original. However, the process is typically repeated a third time. The second-stage approximation is XORed with the original, producing a second-level difference image that will have more black areas than the first one, since it's closer to the original. You then repeat the process to find a third set of reference tiles to represent the second-level difference image.

After three iterations, the approximation will be very close indeed to the original. But how much smaller is it? Suppose the original is a 640-by-480 image with 24-bit color. Since 24-bit color requires 3 bytes to code the color, the uncompressed image will take up 921,000 bytes (3 by 640 by 480 bits). If you used 16 reference tiles all three times, you would have a total of 48 reference tiles. Each refer-

Lossy Compression Toolkits

What do you do if you're a developer and you want to include compression technology in your application? Lossless technology is well established, and there are lots of choices. PKWare, the maker of PKZIP, has long offered a developer's toolkit. Even without the toolkit, the algorithms are simple enough that you can roll your own by starting with sample code from books.

Lossy compression of images is a different matter entirely. There are fewer suppliers, and if you need the technology, you are likely to need it badly. These factors lead to the situation—unusual in the current development-software market—that most lossy-compression toolkits are *not* royalty-free.

Lead Technologies has toolkits for a variety of compression methods, including JPEG (Charlotte, NC 28262; voice, 800-637-4699, 704-549-5532; fax, 704-548-8161). But the company is not limited just to JPEG; it has its own proprietary lossy-compression method, and Lead also sells lossless data-compression toolkits. In addition, Lead sells libraries that can be used for converting graphics files to and from the major bitmapped file types, which include .BMP, .GIF, .PCX, .TGA, and TIFF.

The company's toolkits are mainly C libraries, but there is a Visual Basic Custom Control set, and a set of Microsoft Windows DLLs that is callable from a variety of languages. The 32-bit versions of the toolkits (which Lead says are 3 to 4 times as fast as the 16-bit versions) have associated royalties if you use them in your applications.

Iterated Systems (Norcross, GA 30092, 800-437-2285) owns the patents on Fractal Compression. It provides the technology to developers through a compression SDK (software development kit) called ColorBox ($499). ColorBox is a set of DLLs that can be called from Borland C++, Microsoft C++, or Visual Basic. ColorBox lets you compress 24-bit .BMP and Targa images, and decompresses to .DIB images. The package includes 20 runtime licenses, with additional licenses available on a negotiated basis.

For end users, Iterated Systems provides Images Inc. ($299). Images Inc. has some general-purpose image manipulation tools, as well as JPEG and fractal-compression programs. It supports .BMP, .PCX, Sun Raster, .TGA, and TIFF.—*Barry Simon*

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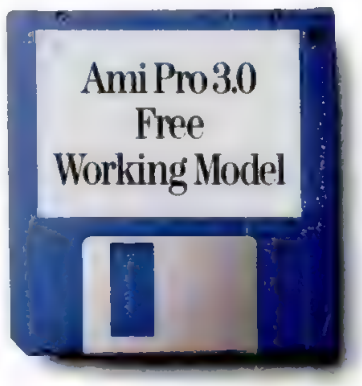

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ence tile takes 768 bytes (256 pixels times 3 bytes for the color of each pixel). So the total for the reference tiles is 36,864 bytes (48 by 768 bytes).

Now we need to associate each of the 1,200 tiles that make up the original image with the three sets of reference tiles. Since there are 16 reference tiles in each set, it takes 4 bits to identify a single reference tile. Identifying three reference tiles requires 12 bits (1.5 bytes). When you add this up for each of the 1,200 tiles, you get a total of 1,800 bytes needed to associate original tiles with reference tiles. Add this to the total for the reference tiles and you end up with a compressed file of 38,664 bytes. How good is this? The original 921,600-byte file has been replaced with one that is just over 4 percent as large!

Like JPEG and RVQ, fractal compression starts by breaking the image into tiles, but then each tile is encoded as a mathematical transformation of other areas within the image.

Actually, this file can be compacted even further by using lossless compression techniques. The 3,600 (1,200 by 3 bits) 4-bit reference-tile identifiers are a natural place to employ arithmetic or Huffman encoding, explained in last issue's Lab Notes. Moreover, the 48 tiles can themselves be compressed by a variety of methods; Knowledge Adventure sometimes uses an additional lossy step for this process.

Although RVQ compression is computation-intensive and thus may take a very long time, decompression is quick and easy. You simply retrieve the reference tiles you've selected and put them together.

FRACTAL COMPRESSION Fractal compression differs from both JPEG and RVQ in that it is resolution-independent. The amount of detail shown on decompression depends upon the resolution of the output device. This unique feat is achieved by storing the image as a set of formulas, rather than as a set of points.

Resolution independence can bring a number of advantages. Images can be decompressed to a size that is different than the original's and can use more or fewer colors than the original used.

Zigzag Order

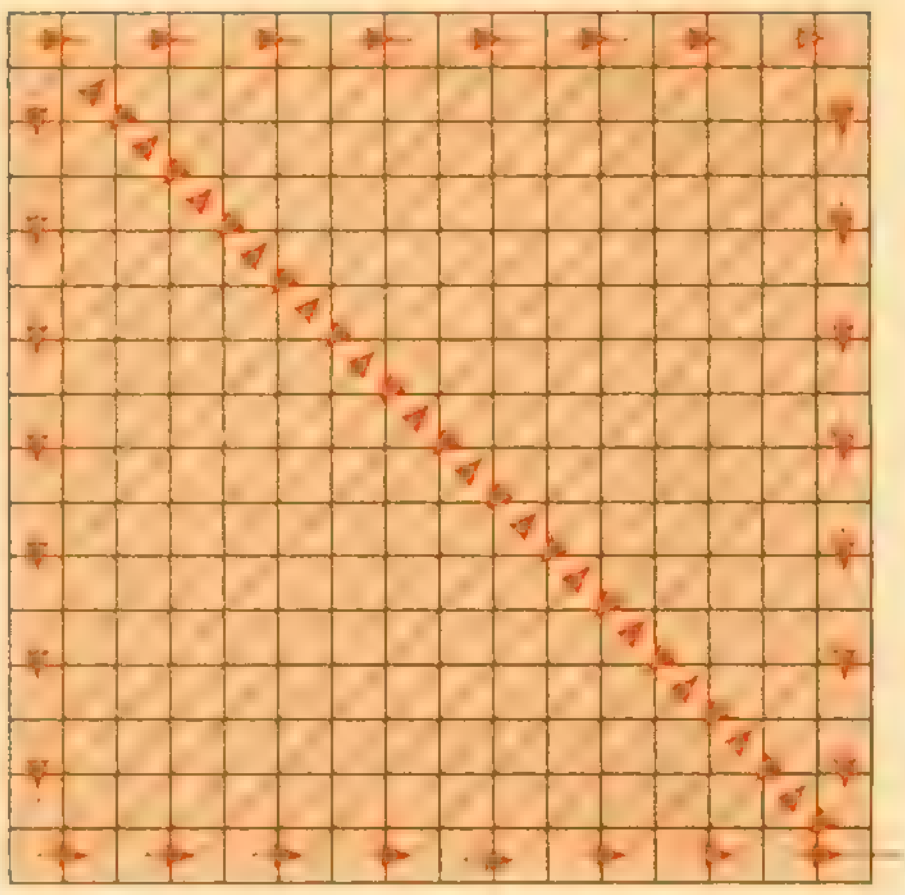

Figure 2: **Zigzag order is used in JPEG compression because it avoids discontinuities; when you get to the end, you turn around and go the other way.**

Fractals are strange mathematical objects that have a number of interesting properties. For one thing, the graphs of many fractals are self-similar; pieces of the image can be described in terms of other pieces of the image. This can be illustrated by considering the Koch fractal, which is popularly known as the *snowflake fractal.*

The Koch fractal begins with a line segment ___. You then put an equilateral triangle in the middle third of the line segment and erase the bottom of the triangle: _/_. Then you take each line segment in the resulting pattern and do the same thing again. Go through enough iterations and you'll get a pattern that looks a lot like a snowflake. It is self-similar in that each part of the snowflake can be described in terms of other parts of the snowflake.

Fractal compression is based on the same self-similar property, and—like the Koch fractal example—multiple iterations are required to build up the decompressed image. It is no coincidence that the name of the company that invented the technology is Iterated Systems.

Like JPEG and RVQ, fractal compression starts by breaking the image into tiles, but then each tile is encoded as a mathematical transformation of other areas (called *reference regions*) within the image. Reference regions may be rotated, scaled, shifted, or all three to find the optimal transformation. The transformed reference region looks almost exactly like the tile being encoded; the longer the time allowed to search for the best region and transformation, the higher the quality of the decompressed image.

In order to find the best reference region and the best transformation for that reference region, you must evaluate a huge number of possibilities. There are innumerable reference regions to consider, and an enormous number of transformations is possible for each candidate reference region. When all this is finished, the code for each tile is the *x,y* coordinate of the upper left-hand corner of the reference region and the transformation function that was applied to it. Images are encoded as a set of functions, one function for each tile.

As you read this, you may wonder how you can ever get back a likeness of the original image if you don't have at least part of that image as a starting point. The answer lies in carefully choosing your set of transformations so that they meet specific mathematical criteria.

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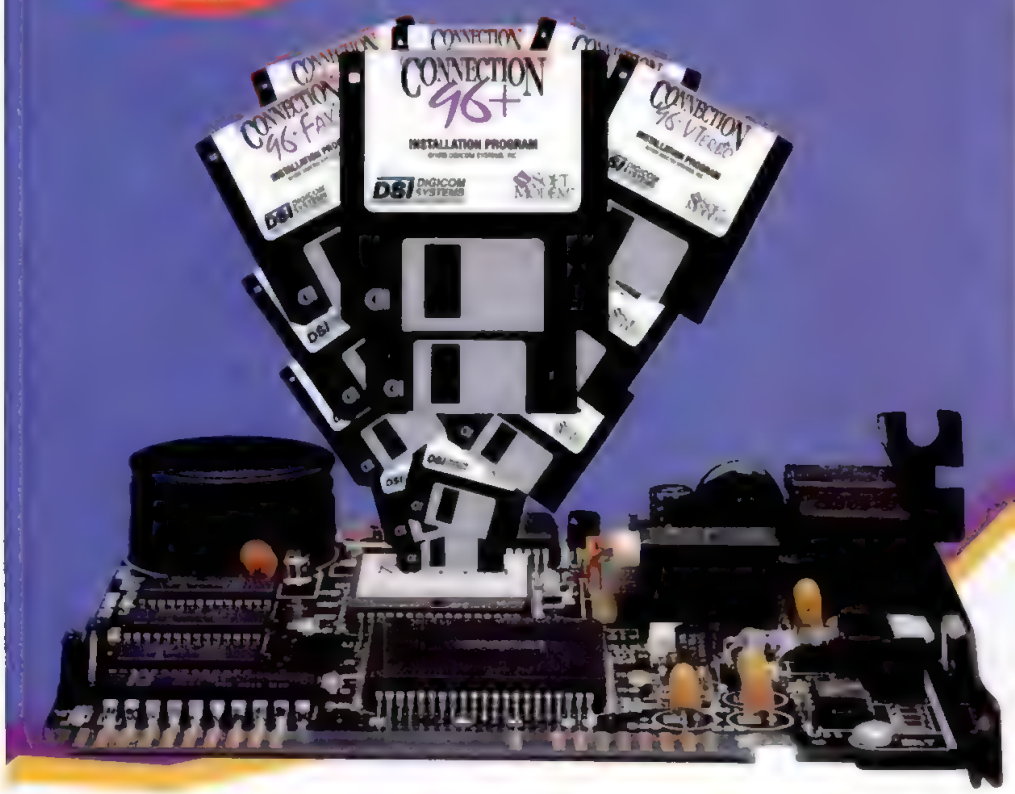

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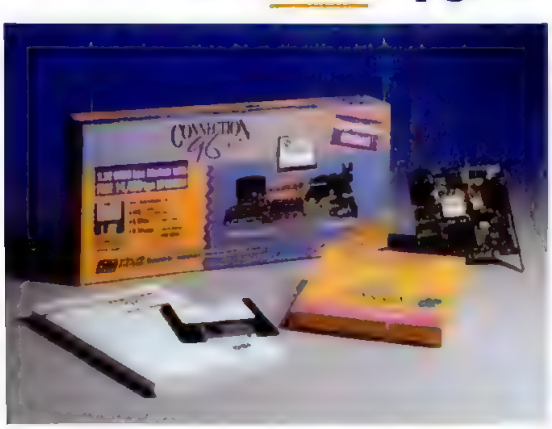

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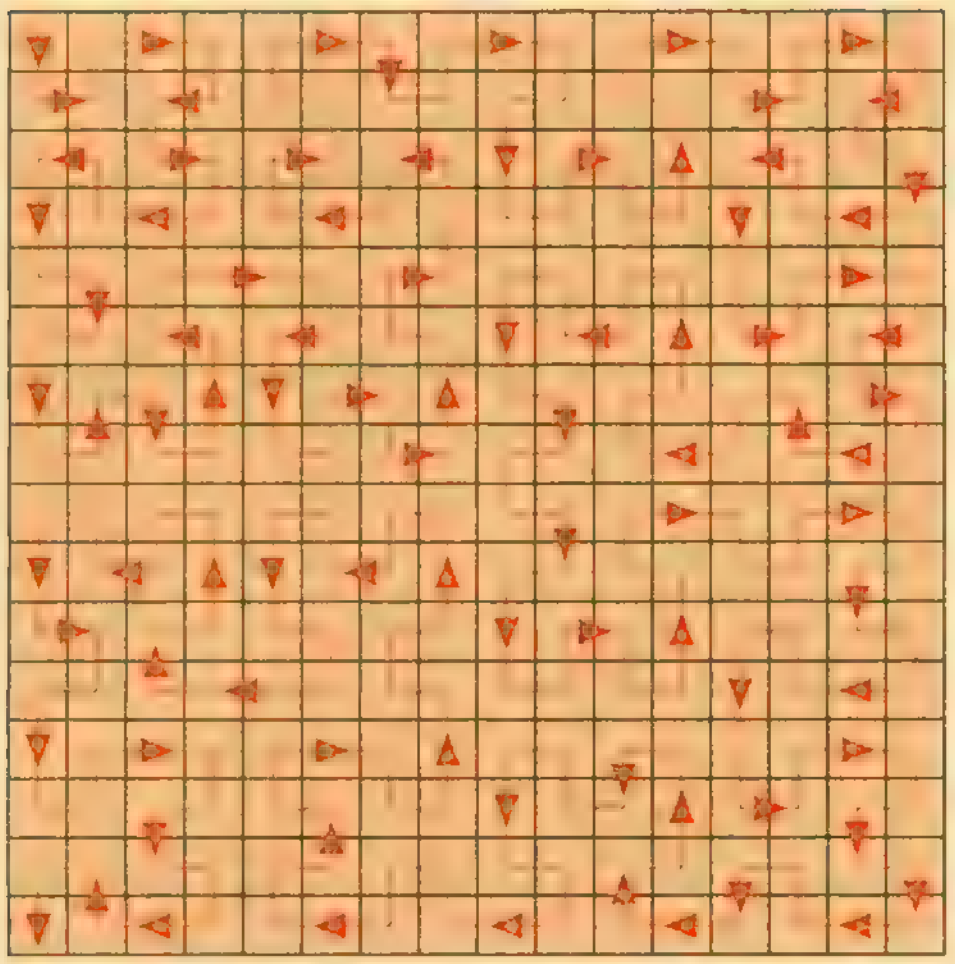

Figure 3: **Hilbert curve order might have been a better choice for JPEG than zigzag order, because it takes into account closeness in more than one direction.**

Certain functions or sets of functions are described as *contractive*. If you take any two numbers and transform them with a contractive function (or *contraction*), you'll find that the two results are closer together than the original numbers with which you started.

For example, consider the following contraction:

```
f(x) = x/2 + 1
```

Applying this function to the integers from 0 to 4, you get

x	f(x)
0	1
1	1.5
2	2
3	2.5
4	3

Notice that no matter which two numbers you choose from the left-hand column, the corresponding numbers in the right-hand column are closer together.

Contractions have another property: they have a single *fixed point*. A fixed point is a value for which `f(x) = x`; that is, the number you put in is the same as the number you get out. For the contraction in the example above, the fixed point is 2, since (2 / 2 + 1) equals 2.

You can always find the fixed point for a contraction. Start with any number and apply the function to it. Then apply the function to each result. With each iteration, you'll find that the result gets closer and closer to some number, and that number is the fixed point. So in our example, if you start with 4, the first result is 3. Then you put 3 in and the result is 2.5. If you keep going, you'll see the number gets closer and closer to 2.

Not only can single functions be contractive, but sets of functions can also be contractive; this is the basis of fractal compression. The fixed point of a set of functions with this property (called an iterated function system, or IFS) is called the *attractor*. The attractor of an IFS for an image is the decompressed image. Just as the fixed point of the contraction in the example above was found by starting anywhere and applying the function iteratively, a fractal-compressed image is decompressed by iteratively applying the IFS. With each iteration, the image gets closer and closer to the attractor—the decompressed image.

To reconstruct the image, you have to start with at least one black pixel. The compressed information for each tile tells you the reference region and the transformation. So to get the first tile, you go to its reference region and apply the transformation, then store the result where the first tile should be. Then you move on to the next tile and do the same thing. One iteration is a complete pass through all the tiles, each time applying the transform function to the associated reference tile. Your first pass result won't look like much, but each successive iteration will get closer and closer to the original image.

Decompressing a fractal-compressed image is straightforward and quick, but compressing it in a reasonable length of time requires clever searching over reference regions and transformations, and you must ensure that the IFS is contractive. Iterated Systems has found efficient methods of doing this, but these are proprietary and undisclosed.

Decompressing a fractal-compressed image is straightfoward, but compressing it requires clever searching over reference regions and transformations.

Image compression is becoming increasingly important because of the emergence of multimedia software. The technology has come far: until very recently, fractal compression could only be accomplished with the aid of add-in cards, and today it can be done with software alone. As far as it has come, however, image-compression technology is still in its infancy and will continue to be an active area of innovation for a long time to come.

For more information about JPEG, take a look at *The Data Compression Book*, by M. Nelson, (published by M&T Publications, 1992, ISBN 1-55851-214-4). Fractal compression is described in M. Barnsley and L. Hurd's book, *Fractal Image Compression*. (AK Peters, 1993, ISBN 1-56881-000-8). □

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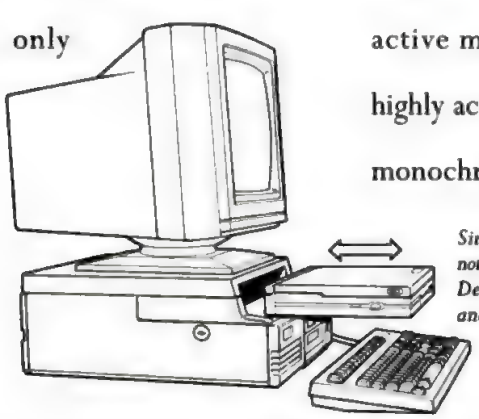

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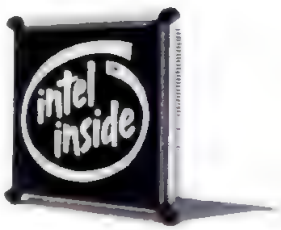

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FIND: A Text-Search Utility for Windows 3.1

BY DOUGLAS BOLING

If you're a DOS or Unix user, you've undoubtedly employed file-search utilities for years. But how do you locate an elusive sentence buried *somewhere* on your disk if you're running under Windows 3.1?

The answer is this issue's free utility, FIND. With FIND you can scan through a single file, a set of files, or an entire partition and find all occurrences of a given string without resorting to the DOS box at all.

Two additional features enhance FIND's attractions. First, the utility does its searching in the background, so you can continue to work on other tasks while it does its job. And second, instead of being a standalone program, FIND seamlessly integrates itself into the Windows File Manager. In this way, the services provided by FIND supplement the already-powerful File Manager. Once installed, FIND becomes simply an additional item on the File Manager menu.

To add FIND to your growing collection of Windows utilities, just download FIND.DLL from PC MagNet, as explained in the accompanying "PC MagNet: Utilities and More" sidebar. The .ZIP file contains both the active part of the program, FIND.DLL, the .DOC file, and its C-language source files.

If you don't have a modem, you can get the same files directly and without charge from *PC Magazine*. Just send a postcard with your name, address, and disk size preference (1.2MB or 1.44MB) to the attention of Katherine West, *PC Magazine*, One Park Ave., New York, NY 10016-5802. No phone calls, please!

USING FIND To install FIND, copy the FIND.DLL file into a directory on your hard disk. You should then edit the File Manager's WINFILE.INI file, adding the following line to its [AddOns] section:

```
Text Search Extension=d:\path
\FIND.DLL
```

For example, because I put FIND in my \WINDOWS\UT directory on my D: drive, I entered

```
Text Search Extension=D:\WINDOWS
\UT\FIND.DLL
```

Note that if your WINFILE.INI doesn't already have an [AddOns] section, you must add it, on a line by itself. If the whole idea of editing .INI files is new to you, see the sidebar "How to Install FIND.DLL"

Now you can find any string in any file, directory, or disk without having to go back to the DOS box.

Once FIND is installed, start the File Manager. You will see that an extra menu item—Find—has been added on the main menu line. For a quick test, select a file in the File Manager window, click on the Find | Text menu item, type in the text to be found, and either press Enter or click the Find button. FIND will then display a list of all occurrences of that text string in the file you selected.

Since FIND is an extension of the File Manager, you can use the File Manager to select the files you want examined. To select a file or directory, simply click on it. If you hold down the Ctrl key while making a selection the new file or directory will be added to the currently selected list. Holding down the Shift key selects all files between the current selection and the new selection. Note, however, that multiple selections can be made only from the file list side of the directory window.

Using the mouse or Alt-N to select the Find menu item on the File Manager's main menu reveals the three-item FIND menu. Its first item, Text, brings up FIND's Text Search dialog box, which is shown in Figure 1. The text to be found is entered in the edit box in the top-left corner. To its right is a combo box that contains a list of the files you selected to search in the File Manager window. If you change your mind you can enter a new file specification directly in the combo box. This will remove any previous selections.

The first check box at the bottom of the dialog box lets you tell FIND to ignore the case of the text during the search. An X in the second check box tells FIND to search through files contained in any subdirectories below the current directory. If you set the directory selec-

Top 10 Utilities

Rank	Utility
1	**DIRMATCH** - *Compare 2 directories*
2	**BAT2EXEC** - *Batch file compiler*
3	**CHKFRAG** - *Checks fragmentation*
4	**PCSPOOL** - *Print spool utility*
5	**INCTRL** - *Installation control*
6	**BUGS** - *Windows 3.1 screen saver*
7	**STRINGS** - *Enhance batch files*
8	**WPRINT** - *Print in Windows 3.1*
9	**CLIPST** - *Extend the clipboard*
10	**PCREM2** - *Access a remote PC*

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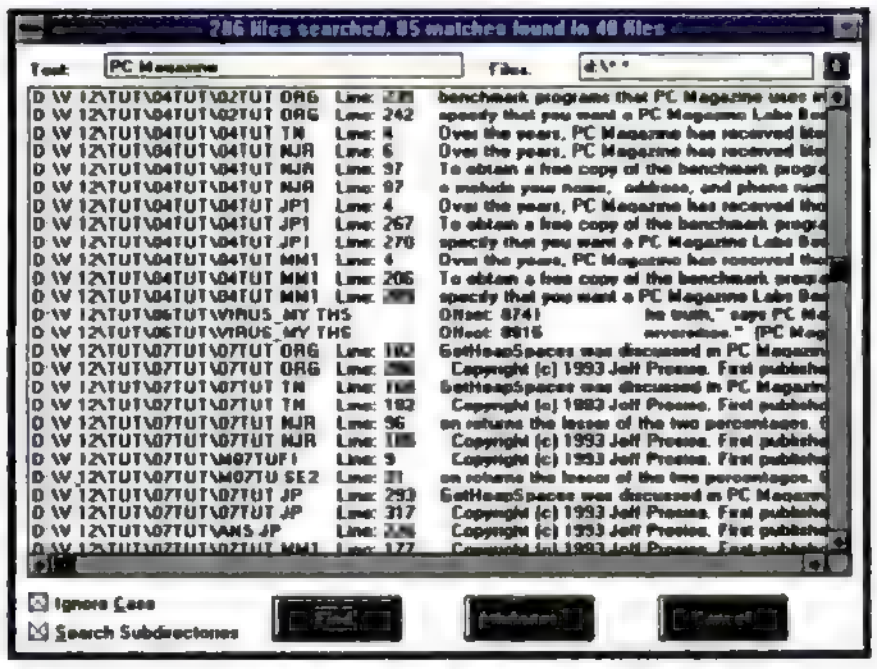

Figure 1: **FIND's Text Search dialog box displays the files to be searched and the text to be found.**

tion to the root directory and then check the Search Subdirectories box, FIND will look for matching text in every file on the disk.

Pressing the Attributes button displays a dialog box that lets you restrict the type of files to be searched. By default, FIND looks at all files that match the filename specification. By using the Attributes dialog, however, you can limit the search to files that have the desired file attributes. There's usually no point in having FIND waste its time going through the hidden files or system files.

Hitting Enter or clicking the Find button starts the search. FIND will display the name of the file it is currently examining in the title bar of the dialog box. This allows you to monitor the progress of the search. When FIND finds the matching text, that line from the file is displayed in the list box, together with the filename and the line number within the file. If the file is not a pure ASCII text file, FIND displays the offset into the file rather than the line number of the matched text.

When you start a search, the Find button changes to read "Stop." Pressing the Stop button immediately aborts the search. When a search is stopped or has been completed, the button changes back to Find. Since FIND performs its search in the background, you can continue to work with programs other than the File Manager while the search is taking place. The only limitation here is that you cannot switch to a full-screen DOS box that has the Exclusive tasking option set. If you do, FIND (along with all your other Windows programs) will be suspended until you switch back to the desktop. The only remaining button on the dialog box is the Cancel button.

The other two items on the main FIND menu are Files and About Find. Selecting the Files menu displays the same dialog you could access from the File Manager's File | Search menu. I simply reduplicated it here to let you use it as part of FIND's search operations. The final menu selection, About Find, contains the usual author and copyright information.

FILE MANAGER EXTENSIONS

The Windows 3.1 File Manager is much improved over its Windows 3.0 predecessor. Along with performance enhancements, Microsoft provided a documented method for adding new functions to the File Manager. The interface is described in the documentation that accompanies the Microsoft Windows Software Development Kit (SDK), Borland's C++ 3.1 compiler, and other Windows 3.1 development environments. Fortunately, the interface is relatively straightforward—for a Microsoft-defined interface. Before discussing how FIND works in detail, it's good to begin with File Manager extensions in general.

A File Manager extension must be implemented as a dynamic link library (DLL) that contains an external entry point with the name FMExtensionProc. When the File Manager is launched, it looks in the [AddOns] section of its WINFILE.INI file for the names of any extension DLLs. The File Manager reads the names listed there and loads each DLL into memory. If a listed DLL cannot be found, the File Manager does not display an error; it just proceeds to the next extension in the list. This allows an extension to be removed simply by deleting the DLL, although it is good practice to delete the [AddOns] entry as well.

Communication between the File Manager and an extension DLL is performed through messages. When the File Manager wants to send a message to an extension, it does not send the message to the extension's window; instead, it calls FMExtensionProc. When the extension wants to send a message to the File Manager, it uses the standard Windows SendMessage() function to send a message back to the File Manager window. The File Manager will respond correctly only to messages sent from the FMExtensionProc function. Unfortunately, this means that programs other than extensions cannot use these messages to query the File Manager for information.

The File Manager calls FMExtensionProc with three parameters: the handle

File Manager Messages

Messages from the File Manager to the extension	
Messages 1 to 99	Sent when the user selects one of the extension's menu items.
FMEVENT_LOAD	Sent when the File Manager loads the extension.
FMEVENT_INITMENU	Sent when the user selects the extension's main menu selection.
FMEVENT_SELCHANGE	Sent when the user changes the selection in the File Manager's directory or search window.
FMEVENT_USER_REFRESH	Sent when the user clicks on the File Manager's Refresh Windows button.
FMEVENT_UNLOAD	Sent when the File Manager unloads the extension.

Message from the extension to the File Manager	
FM_GETDRIVEINFO	Returns information about the currently selected disk drive.
FM_GETSELCOUNT	Returns the number of selections in the File Manager window.
FM_GETFILESEL	Returns directory entry information for a selected file.
FM_GETSELCOUNTFN	Same as FM_GETSELCOUNT except that the count includes any selections with long filenames.
FM_GETFILESELFN	Same as FM_GETFILESEL except that the filename returned may be longer than the standard 8.3 file-naming convention allows.
FM_GETFOCUS	Returns the type of the File Manager window with the active focus.
FM_REFRESH_WINDOWS	Tells the File Manager to refresh its windows.
FM_RELOAD_EXTENSIONS	Tells the File Manager to unload then reload all its extensions.

Figure 2: **These messages are used to communicate between the File Manager and a File Manager extension.**

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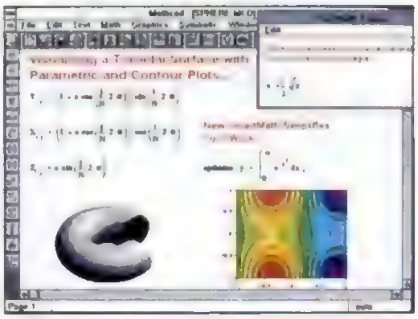

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of the File Manager window, a number indicating the message type, and an lParam parameter that contains message-specific information. Figure 2 lists the messages used to communicate between the File Manager and the extension. The File Manager also calls the FMExtensionProc when the user selects any of the extension's menu items.

When the File Manager loads an extension DLL, it sends an FMEVENT_LOAD message to the extension. The lParam parameter contains a pointer to an FMS_LOAD structure. Figure 3 contains the C-style definition for FMS_LOAD and for the other structures used in the File Manager extension interface. When the extension is called, the only field that is filled in by the File Manager is the wMenuDelta field, which I'll discuss shortly.

Before returning from the FMEVENT_LOAD call, the extension must fill in the dwSize, szMenuName and hMenu fields in the FMS_LOAD structure. The first field, dwSize, is a (rather optimistically large) double-word parameter that contains the size of the structure. The szMenuName parameter is the menu name that the File Manager will use to label the extension's menu on the File Manager's main menu. In keeping with Windows standards, this string may contain an ampersand (&) character preceding the character to be underlined in the menu item.

The hMenu field is filled with the handle of the extension submenu to be displayed when the user selects the extension's main menu item. Normally, the extension uses a LoadMenu call to load this menu from its resource information. The items in an extension's menu must have IDs in the range of 1 to 99. When the user selects one of the extension's menu items, the File Manager calls FMExtensionProc with a message number set to the ID value of the menu item. Thus, a File Manager extension processes its menu selections in FMExtensionProc, not—as in a typical Windows program—in a WM_COMMAND message.

The documentation for the FM_EVENTLOAD message mistakenly in-

dicates that the extension should not return a value for this message. The extension *must* return the hMenu value or the extension will not be loaded. Fortunately, this documentation error is not duplicated in the example shown in the File Manager extension overview.

An FMEVENT_INITMENU message is sent to the extension when the user selects the extension's main menu item on the File Manager menu. The message is sent before the extension menu is displayed, and it allows the extension to perform any menu initialization processing needed. Such menu initializations might include disabling or checking menu items. If the extension's menu contains submenus, these must also be initialized at this time, as no other notifications are sent when the submenus are displayed. The lParam parameter contains the extension's menu handle in the high word and the wMenuDelta parameter in the low word.

The wMenuDelta parameter is a number that the extension must use when manipulating its own menu items. When the File Manager loads an extension, it selects a wMenuDelta value that is higher than all its other menu IDs. It then adds this wMenuDelta value to the extension's menu IDs so that they will be unique. When the user selects one of these items, the File Manager sends its original menu ID from 1 through 99 to the extension, but if an extension needs to modify a menu directly, it must use the wMenuDelta value to compute the real menu ID. Thus, for example, FIND has three menu items, Text, Files, and About, which have ID numbers 1, 2, and 3. To disable the Files menu item, the extension would use

```
EnableMenuItem (hMenu, 2 +
 wMenuDelta, MF_BYCOMMAND |
 MF_GRAYED);
```

The hMenu parameter in this example is the handle to the extension menu.

The FMEVENT_SELCHANGE message is sent to the extension when the user changes the selections in the File Manager window. This message allows the extension to update its display with the new selections. The lParam parameter is not used in this message.

The FMEVENT_USER_REFRESH message is sent when the user selects the File Manager's Window | Refresh menu item. This message indicates that the extension should update its menus and windows to reflect the current situation. As with the FMEVENT_SELCHANGE message, the lParam parameter is not used.

Finally, the FMEVENT_UNLOAD message is sent to the extension when the File Manager unloads the extension DLL. This message allows the extension to perform any cleanup needed before being removed from memory. Again, the lParam parameter is not used. While the extension can use this message for cleanup, the DLL's WEP (Windows exit procedure) routine will also be called by Windows' KERNEL module just before the DLL is unloaded from memory.

During any of the FMEVENT messages, the extension can send a number of messages to the File Manager to query its current state. The FM_GETDRIVEINFO message is used to return information about the currently selected disk drive. This message is sent with SendMessage's lParam parameter pointing to an FMS_GETDRIVEINFO structure; the wParam parameter is not used. FMS_GETDRIVEINFO contains such information as the drive's total space, free space, current path, volume name and share name.

How to Install FIND.DLL

In order to install the FIND utility, simply follow these step-by-step instructions:

1. Copy the file FIND.DLL into your Windows (or another convenient) directory.

2. Start Notepad by double-clicking on the Notepad icon in the Accessories group.

3. Open the File Manager's .INI file by selecting the File | Open menu selection in Notepad and entering WINFILE.INI.

4. Find the [AddOns] section in the file. If there is no [AddOns] section, go to the end of the file and enter [AddOns] on a line of its own.

5. Just under that line, add the line

```
Text Search Extension=FIND.DLL
```

If you didn't place FIND.DLL in your Windows directory, include the path to the DLL in the filename.

6. Save the file by selecting the File | Save menu item.

7. Close Notepad by selecting the File | Exit menu item.

Structures Used in the File Manager Extension Interface

```
typedef struct FMS_LOAD {
    DWORD dwSize;
    char  szMenuName[MENU_TEXT_LEN];
    HMENU hMenu;
    UINT  wMenuDelta;
} FMS_LOAD;

typedef struct FMS_GETDRIVEINFO {
    DWORD dwTotalSpace;
    DWORD dwFreeSpace;
    char  szPath[260];
    char  szVolume[14];
    char  szShare[128];
} FMS_GETDRIVEINFO, FAR *LPFMS_GETDRIVEINFO;

typedef struct FMS_GETFILESEL {
    UINT  wTime;
    UINT  wDate;
    DWORD dwSize;
    BYTE  bAttr;
    char  szName[260];
} FMS_GETFILESEL;
```

Figure 3: **The C-style definitions for FMS_LOAD, FMS_GETDRIVEINFO, and FMS_GETFILESEL, which are used in the File Manager extension interface.**

Electronic Mail Evaluation Chart

	E-Mail Features	Microsoft Mail	Lotus® cc:Mail™
Administration	1. Automated Directory Synchronization with built-in fault tolerance	☑	☐
	2. Capacity to synchronize across backbone of a foreign system	☑	☐
	3. Common gateway and server administration program	☑	☐
	4. Batch User Creation Facility	☑	☑
	5. Graphical Move User Facility	☑	☐
	6. Computer-based Training for new users	☑	☐
Scalability	1. Circular route detection of mail messages	☑	☐
	2. Hop count tracking to detect routing errors across complex networks	☑	☐
	3. Multitasking MTA (message transfer agent)	☑	☑
	4. Wide Area Network (WAN) support	☑	☑
Gateways	1. Backbone capacity through other mail systems	☑	☐
	2. Encapsulation to ensure message integrity	☑	☐
	3. Automated notification of gateway status	☑	☐
	4. Integrated X.400 MTA and gateway	☑	☐
	5. Fax directly from any Windows-based application	☑	☐
Platforms	1. Client for Windows	☑	☑
	2. Client for MS-DOS	☑	☑
	3. Client for Macintosh	☑	☑
	4. Client for OS/2	☑	☑
	5. Client for UNIX®	☐	☑
	6. Remote client for MS-DOS	☑	☑
	7. Remote client for Windows	☑	☐
	8. Server for MS-DOS	☑	☑
	9. Server for Macintosh	☑	☐
	10. Multiplatform client software included in the server box	☑	☐

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The FM_GETFILESELCOUNT message can be used to query the number of items selected in the File Manager's directory and search windows. The File Manager returns the number of selected files and directories in the return value of SendMessage. Neither the wParam nor the lParam parameters of SendMessage are used for this message.

Once an extension knows how many files have been selected, it can send an FM_GETFILESEL message to retrieve each of their names. For this message, wParam contains the index of the file in which the extension is interested, and lParam points to an FMS_GETFILESEL structure. When the message returns, the structure is filled with information about the file, including its name, size, attributes, and the date and time the file was created.

FM_GETSELCOUNTFN and FM_GETFILESELFN are similar to the FM_GETSELCOUNT and FM_GETFILESEL messages except that they also return information on selected files whose filenames are longer than the standard 8.3 DOS format. Although DOS does not itself recognize these long filenames, this support is provided for File Manager extensions that may operate on network files with nonstandard filenames.

Depending on the type of window that currently has the focus in the File Manager, the FM_GETFOCUS message returns one of four values. The four window types are the directory portion of the directory window, the tree portion of the directory window, the drive selection bar, and the search results window.

The last two File Manager messages, FM_REFRESH_WINDOWS and FM_RELOAD_EXTENSIONS, give the extension a little bit of control over what is presented in the File Manager windows. The FM_REFRESH_WINDOWS message can be sent to instruct the File Manager when you want to update its windows. This comes in handy if an extension creates, deletes, or moves files and wants the File Manager to display the state of the disk accurately. If the wParam parameter is zero, the File Manager updates the active window; otherwise all File Manager windows are updated.

The FM_RELOAD_EXTENSIONS message instructs the File Manager to unload and then reload all of its extensions. The File Manager rereads its WINFILE.INI file to see what extensions need to be reloaded. This message is convenient when an extension wants to unload itself. It can remove its entry from WINFILE.INI and then send the FM_RELOAD_EXTENSIONS message to force the File Manager to reload all the other extensions.

FIND.DLL
Partial Listing

```
LONG DoFMExtInitMenu (HWND hWnd, UINT wMsg, LONG lParam) {
   INT  i, sCnt;
   BOOL  bFound = FALSE;
   HMENU  hMenu;

   // Get 'File' Menu
   hMenu = GetMenu (hWnd);
   sCnt = GetMenuItemCount (hMenu);
   for (i = 0; i < sCnt; i++) {
      GetMenuString (hMenu, i, szFileSpec, sizeof (szFileSpec),
                     MF_BYPOSITION);
      if (strcmp (szFileSpec, '&File') == 0) {
         hMenu = GetSubMenu (GetMenu (hWnd), i);
         bFound = TRUE;
         break;
      }
   }
   // Get Search menu
   if (bFound) {
      sCnt = GetMenuItemCount (hMenu);
      for (i = 0; i < sCnt; i++) {
         GetMenuString (hMenu, i, szFileSpec, sizeof (szFileSpec),
                        MF_BYPOSITION);
         if (strcmp (szFileSpec, 'Searc&h...') == 0) {
            wSrchMenuID = GetMenuItemID (hMenu, i);
            bFound = TRUE;
            break;
         }
      }
   }
   hMenu = HIWORD (lParam);
   if (bFound) {
      EnableMenuItem (hMenu, IDM_FFIND + LOWORD (lParam),
                      MF_BYCOMMAND | MF_ENABLED);
   } else
      EnableMenuItem (hMenu, IDM_FFIND + LOWORD (lParam),
                      MF_BYCOMMAND | MF_GRAYED);
   return 0;
}
```

Figure 4: **FIND uses this code to process the FMEVENT_INITMENU message from the File Manager.**

INSIDE FIND FIND.DLL is a simple Windows DLL. It has the standard LibMain and WEP external entry points, the required FMExtensionProc entry point, and entry points for the dialog boxes. As with all DLLs, LibMain is called by Windows when the DLL is loaded. During the LibMain call, FIND reads the WINFILE.INI file to get its last-saved configuration. FIND stores its configuration data in the section labeled [Text Search Information]. The configuration data, items such as the directory search flag, and the file search attributes are stored in global variables.

The File Manager then sends the FMEVENT_LOAD message to FIND by calling FMExtensionProc. FIND stores the wMenuDelta parameter and initializes the remainder of the FMS_LOAD structure. This requires filling in the size parameter, copying the string "Find" into the menu-name field, saving the FIND menu handle (loaded with a LoadMenu call) in the structure, and returning the menu handle.

When FIND receives an FMEVENT_INITMENU message, it searches the File Manager's File menu items to find the File Manager's own File | Search menu item. If the menu item is found, the menu ID is saved and the FIND Files menu is enabled. If the Search menu cannot be found, the FIND Files menu will be disabled. The FIND code that is used to process the FMEVENT_INITMENU mes-

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sage from the File Manager is shown in Figure 4.

When the user selects one of the three FIND menu items, the File Manager calls FMExtensionProc with the ID number for that particular menu. The processing for these items is straightforward. For the Text and About Find menus, FIND simply displays the appropriate Text Search or About dialog box. For the Files menu, FIND posts a WM_COMMAND message back to the File Manager window with the ID of the File Manager's own File | Search menu item that is contained in the wParam parameter. Sending the WM_COMMAND message causes the File Manager to display its File Search dialog.

The File Manager extension interface allows other companies to integrate their products into the File Manager.

FIND does not process the FMEVENT_SELCHANGE, FMEVENT_USER_REFRESH, or FMEVENT_UNLOAD messages. The first two of these messages are not processed because FIND's Text Search dialog is a modal dialog box. When the Find Text dialog is being displayed, Windows prevents users from selecting any File Manager menu items or changing any of the selections in the File Manager window. The UNLOAD message is not processed because FIND does not need to perform any processing before it is unloaded. The remainder of the FIND code deals with the job of searching the file for the matching text. FIND saves its configuration information during the WEP call from Windows, immediately before the DLL is unloaded.

FIND uses the brute-force method to search for the matching text. Each file is opened, read into a buffer, and scanned for the text. After scanning all the selected files in a directory, the directory is examined for subdirectories if the Search Subdirectories check box is checked. In that case, when a subdirectory is found, the text-search routine calls itself recursively to scan for the text in the files of that subdirectory. The text-search routine uses one 32K buffer for reading in the files, and it allocates small, 200-byte local memory blocks to hold directory-specific information.

The File Manager extension interface embodies the true spirit of the personal computer: It is an open interface that allows other companies to integrate their products into the File Manager. Let's hope this trend toward open interfaces continues. In the meantime, FIND removes one more excuse for shelling out to the DOS box. □

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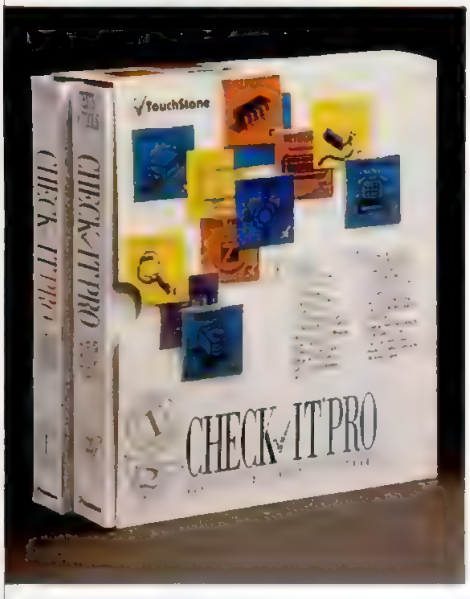

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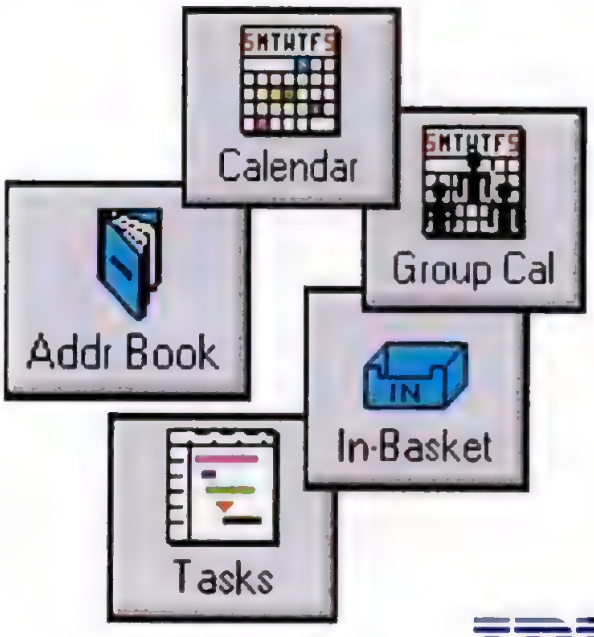

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Windows and Multitasking: A Long Time Coming

BY CHARLES PETZOLD

Years before IBM introduced its first personal computer, I programmed on another IBM computer called the 370. The 370 was a mainframe—a mammoth conglomeration of hardware occupying a chilly floor of the office building where I worked. Hundreds of people in the company used this machine, mostly from 3278 terminals under a system called TSO (time-sharing option). TSO distributed processing time among all the terminals, making it seem as if everyone were using his own computer—albeit a very slow one. Indeed, many people thought of TSO as an intrinsically slow system.

From all those years I worked on TSO, I remember one day in particular: There was a very severe snowstorm, and although the company didn't close, very few people actually showed up for work. On that day I had the 370 almost to myself, and it positively flew. I got more programming, compiling, and debugging done that one day than in the previous two weeks! Of course, mainframes weren't made to be used by just a single user, which is why operating systems for interactive mainframes always support multiple users, and why they use multitasking to divide processing time among those users.

It has taken much longer for multitasking operating systems to come to personal computers, but we now seem to be approaching an era when they will be common. To some extent (as I'll discuss in this column) the DOS-based version of Windows supports multitasking, and perhaps by the time you read this column, Microsoft will have finally released Windows NT, a 32-bit version of Windows that supports both true multitasking and multithreading.

In the next few installments of Environments, we'll be examining multitasking and multithreading as implemented under Windows NT.

MULTITASKING UNDER DOS In the early days of the PC, some people advocated multitasking for the future, but many others just scratched their heads in puzzlement: Of what possible use could multitasking on single-user personal computers be to them? Well, it turned out that multitasking was something most users wanted without really knowing that they wanted it at all.

It's been a long wait, but finally Windows NT brings both true multitasking and multithreading to the personal computer.

The Intel 8088 microprocesssor used in the original PC was not exactly built for multitasking. Part of the problem was memory. As multiple programs are started and ended, a multitasking operating system is often called upon to move memory blocks around to consolidate free space. This was not possible on the 8088 in a manner transparent to applications.

DOS itself didn't help much. Designed to be small and to stay out of the way of applications, DOS supported (and still supports) very little beyond loading programs and providing them with access to the file system.

Still, however, creative programmers in the early days of DOS found a way to overcome those obstacles, mostly with TSR (terminate and stay resident) programs. Some TSRs, like print spoolers, hooked into the hardware timer interrupt to perform true background processing. Others, like pop-up utilities such as SideKick, could perform a type of task switching—suspending an application while the pop-up was running. DOS was also progressively enhanced to provide support for TSRs. Some software vendors attempted to mold task-switching or multitasking shells on top of DOS (such as Quarterdeck's DESQview), but only one has achieved a large market penetration. That, of course, is Windows.

NONPREEMPTIVE MULTITASKING When Microsoft introduced Windows 1.0 in 1985, it was the most sophisticated solution yet devised to the limitations of DOS. Back then Windows ran in real mode, but even so it was able to move memory blocks around in physical memory—a prerequisite for multitasking—in a way that was not quite transparent to applications but was almost tolerable.

Multitasking makes a lot of sense in a graphical windowing environment, much more so than in a command line single-user operating system. For example, in command line Unix (and its variants), it is possible to execute programs from the command line so that they run in the background. However, any display output from the program must be redirected to a file or it will get mixed up with whatever else the user is doing.

A windowing environment allows multiple programs to run together on the same screen. Switching back and forth becomes trivial, and it also becomes possible to quickly move data from one program to another. Data transfer has been supported in various ways under Windows, first with the Clipboard, and later through Dynamic Data Exchange

(DDE) and Object Linking and Embedding (OLE).

Yet the multitasking implemented in Windows was not the traditional preemptive time-slicing found in multiuser operating systems. Those operating systems use a system clock to periodically interrupt one task and restart another. A task can be interrupted and later resumed at almost any point, entirely under the control of the operating system.

Instead, Windows supported something called *nonpreemptive multitasking.* This type of multitasking is possible because of the message-based architecture of Windows. In the general case, a Windows program sits dormant in memory until it receives a message. These messages are often the result of user input through the keyboard or mouse. After processing the message, the program returns control to Windows.

Windows does not arbitrarily switch control from one Windows program to another based on a timer tick. Instead, any task switching takes place when a program has finished processing a message and has returned control to Windows. This nonpreemptive multitasking is also called *cooperative multitasking* because it requires some cooperation on the part of applications. It's possible that one Windows program can tie up the whole system if it takes a long time processing a message.

(Although nonpreemptive multitasking has been the general rule in Windows, some forms of preemptive multitasking are also present. Windows uses preemptive multitasking for running DOS programs, and also allows dynamic link libraries to receive hardware timer interrupts for multimedia purposes.)

Windows includes several features to help programmers solve—or at least cope with—the limitations of nonpreemptive multitasking. The most notorious is, of course, the infamous hourglass mouse cursor. This is not a solution, certainly, but just a way of letting the user know that a program is busy working on a lengthy job and that the system will be otherwise unusable for a little while. Another partial solution to this problem is the Windows timer, which allows a program to receive a message and do some work at periodic intervals. The timer is often used for clock applications and animation.

Another solution to the limitations of nonpreemptive multitasking is the PeekMessage function call. Normally a program uses the GetMessage call to retrieve the next message from its message queue. However, if there are no messages in the message queue—and no other application has any pending messages—then GetMessage will not return control until a message is present.

PeekMessage, on the other hand, returns control to the program even if no messages are pending. Thus, a program can perform a long job and intermix PeekMessage calls in the code. The long job will continue running as long as there are no pending messages for the program or any other program.

Of course, once software developers figured out that Windows was nonpreemptive, they began asking the folks at Microsoft when Windows would support preemptive multitasking. The stock answer from Redmond was that Windows would be preemptive when the underlying operating system became preemptive.

PM AND SERIALIZED MESSAGE QUEUES For a while it seemed as if that new underlying operating system would be OS/2, and the preemptive version of Windows—much transformed in the process—would be known as the Presentation Manager. (Well, at least IBM still thinks so!) Although OS/2 certainly supports preemptive multitasking, it often doesn't seem as if this preemption was carried over into the Presentation Manager. The problem is that PM serializes user input messages from the keyboard and the mouse. What this means is that PM will not deliver a keyboard or mouse message to a program until the previous user input message is fully processed.

Keyboard and mouse messages are just a few of the many messages a Presentation Manager program can receive; most of the other messages are the result of a keyboard or mouse event. For example, a menu command message is the result of the user's making a menu selection using the keyboard or mouse. The keyboard or mouse message is not fully processed until the menu command message is processed.

The primary reason for the serialized message queue is to allow predictable type-ahead and mouse-ahead. If one of the keyboard or mouse messages causes a shift in input focus from one window to another, then subsequent keyboard messages should go to the window with the new input focus. So the system doesn't know where to send a subsequent user input message until the previous ones have been processed.

Are type-ahead and mouse-ahead worth the trade-off? The current consensus is that it should not be possible for one application to tie up the entire system, and that requires a deserialized message queue. Indeed, some people from IBM have publicly mentioned this as a goal in a future version of OS/2. Currently the only way to stop an errant OS/2 application that has blocked message processing is to kill it entirely.

THE MULTITHREADING SOLUTION Besides supporting multitasking, OS/2 also supports multithreading. Programs can split themselves into separate pieces (called *threads*) that run concurrently. The support of threads turned out to be the best solution to the problem of the serialized message queue in the Presentation Manager.

In terms of code, a thread is a function that might call other functions. A program begins execution with its main (or primary) thread, which in a traditional C program is the function called *main.* Once running, the program can create new threads of execution by making a system call specifying the name of the function for the thread. The operating system preemptively switches control among the threads in much the same way it switches control among programs.

Each thread in a PM program can either create a message queue or not. A thread must create a message queue if it wishes to create windows from that thread. Otherwise a thread needn't create a message queue if it's just doing a lot of data crunching or graphics output. Because the nonmessage-queue threads do not process messages, they cannot hang the system. The only restriction is that a nonmessage-queue thread cannot send a message to a window in a message-queue thread, or make any function call that causes a message to be sent. (They

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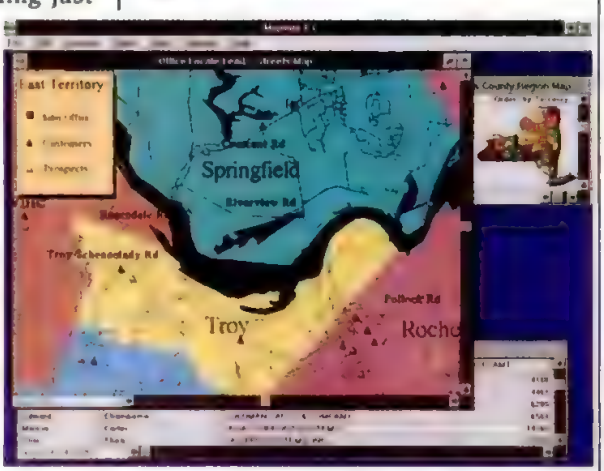

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CIRCLE 291 ON READER SERVICE CARD

can, however, *post* messages to message-queue threads.)

Thus PM programmers learned how to divide their programs into one message-queue thread that created all the windows and processed messages to them, and into one or more nonmessage-queue threads that performed lengthy background tasks. PM programmers also learned about the "1/10 second rule." Basically, they were advised that a message-queue thread must spend no more than 1/10 of a second processing any message. Anything that takes longer should be done in a different thread. If all programmers followed this rule, no PM program could hang the system for more than 1/10 of a second.

One way to think of this is that the message-queue thread handles user input (and other messages), perhaps creating new nonmessage-queue threads in the process. These additional threads do their stuff in the time between the user's keystrokes and mouse clicks.

The results—perhaps implemented most dramatically in Aldus's PageMaker for OS/2 a couple of years ago—seemed to herald a new generation of applications that avoided the hourglass cursor entirely by farming out all lengthy jobs to threads.

Threads within a particular program are all parts of the same process, so they share the process's resources, such as memory and open files. Because threads share the program's memory, they also share static variables. However, each thread has its own stack, so automatic variables are unique to each thread. Each thread also has its own processor (and math coprocessor) state that is saved and restored during thread switches.

Properly designing, coding, and debugging a complex multithreaded application is conceivably one of the most difficult jobs a programmer can encounter. Because a preemptive multitasking system can interrupt a thread at any point to switch control to another thread, any undesirable interaction between two threads may show up only occasionally, and seemingly on a random basis.

One common bug in a multithreaded program is called a *race condition.* This happens when a programmer assumes that one thread will finish doing something—for example, preparing some data—before another thread needs that data. To help coordinate thread activity, OS/2 also implemented semaphores, which allow the programmer to block the execution of a thread at a certain point in the code until another thread signals that it can resume. Similar to semaphores are *critical sections,* which are sections of code that cannot be interrupted.

But semaphores can also introduce another common thread-related bug, which is called a *deadlock.* This occurs when two threads have blocked each other's execution and can only unblock that execution by proceeding.

Fortunately, 32-bit programs are more immune to certain problems involving threads than 16-bit programs. For example, suppose one thread executes the simple statement

```
lCount++ ;
```

where lCount is a 32-bit global variable that is used by other threads. In a 16-bit program, that single statement in C is compiled to two machine code instructions, the first incrementing the low 16 bits of the variable and the second adding any carry into the high 16 bits.

Suppose the operating system interrupts the thread between those two machine code instructions. If lCount was 0x0000FFFF before the first machine code instruction, then lCount will be 0 at the time the thread is interrupted, and that's the value another thread will see. Only when the thread resumes will lCount be incremented to its proper value of 0x00010000. This is one of those bugs that might cause an operational problem so infrequently that it is never detected. In a 16-bit program, the proper way to solve the problem would be to enclose the statement inside a critical section, during which the thread cannot be interrupted. In a 32-bit program, however, the statement is fine because it is compiled to a single machine code instruction.

MULTITASKING IN WINDOWS NT I used to think of the OS/2 Presentation Manager as a second draft of Windows, coming about when the original Windows developers applied the lessons they learned from putting Windows together. The changes were generally good ones, but unfortunately PM never achieved very much in the market. These days, I think of Windows NT as a second draft of OS/2. Windows NT is what OS/2 should have been in the first place—a preemptively multitasking 32-bit version of Windows. Windows NT has many of the same features of OS/2, including threads, semaphores, and critical sections, but throws in some other goodies as well.

The first piece of good news for users is that Windows NT has a deserialized message queue. The implementation of this seems very good: If a program is taking a long time processing a message, then the mouse cursor appears as an hourglass when the mouse is over that program's window, but it changes to a normal arrow when positioned over another program's window. A simple click can bring that other window to the foreground. (Try doing that under the Presentation Manager!)

Properly designing, coding, and debugging a complex multithreaded application is conceivably one of the most difficult jobs a programmer can encounter.

Some more good news: There is no distinction between message-queue threads and nonmessage-queue threads. Each thread in a Windows NT program gets its own message queue when the thread is created. This reduces some of the awkward rules for threads that exist in a PM program. Still more good news: Windows NT has a function that allows one thread to kill another thread in the same process. As you'll discover when you begin writing multithreaded code, this is sometimes very convenient. Why OS/2 did not—and still does not—have such a function is one of the great mysteries of our age. Back in the days when Microsoft still played a part in OS/2 devel-

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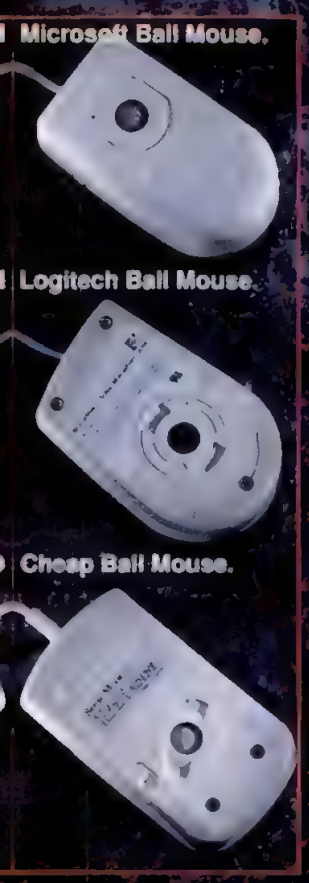

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opment, software developers and technical writers persistently appealed to Microsoft for a kill-thread function. (I know, because I was one of those petitioners and Ray Duncan was another!) The best we could figure was that some design flaw in OS/2 prohibited such a function. Well, that's not the case with Windows NT, and it makes thread handling easier.

The final good news (at least for this topic) is that Windows NT has implemented something called *thread local storage* (TLS). To understand this, recall that I mentioned earlier that static variables (both global and local to a function) are shared among threads because they sit in the process's data memory space. Automatic variables (which are always local to a function) are unique to each thread because they occupy space on the stack, and each thread has its own stack.

It is sometimes convenient for two or more threads to use the same function, and for these threads to use static variables that are unique to the thread. That's thread local storage. There are a few Windows NT function calls involved, but Microsoft has also added an extension to the C compiler that makes the use of thread local storage more transparent to the programmer.

THREADS AND MULTIPROCESSING Multitasking on a single-processor computer is, of course, basically an illusion. The microprocessor time is quickly shifted among threads to make it appear as if they were executing concurrently.

But that's not necessarily the case with Windows NT: One additional advantage of NT over OS/2 is that NT can also run on multiprocessor computers, that is, on machines that have more than one microprocessor. Windows NT supports a type of multiprocessing called *symmetric multiprocessing*, in which the multiple microprocessors are allocated dynamically to run individual threads as they are needed. (In other words, two or more processors do not execute the same thread simultaneously.) In the usual case, people really work with only one application at a time. To be sure, some other application may be printing (or doing some other work) in the background, but it's just not the usual case. If you're running Windows NT on a multiprocessor machine, and you're using a single-threaded application, then the other processors are mostly sitting around doing nothing. You're still essentially running a single-processor computer.

What this implies is that multithreading provides an important speed advantage on multiprocessor machines. Indeed, some long-running algorithms could be restructured to take advantage of multiprocessing. This is particularly feasible if the algorithm uses recursive functions.

NEW! IMPROVED! NOW WITH THREADS! Now that I've made the case for threads, let's put the subject in proper perspective. Sometimes there's a tendency to use every feature that an operating system has to offer. The worst case is when your boss comes to your desk and says, "I've heard that this new XYZ thing is really hot. Let's incorporate some XYZ in our program." And then you spend a week trying to figure out how XYZ can possibly benefit the application.

The point to remember is that it just doesn't make sense to add multithreading to an application that doesn't need it. Some do not. If your program displays the hourglass cursor for an annoying period of time, or if it uses the PeekMessage call to avoid the hourglass cursor, then restructuring the program for multithreading is probably a good idea. Otherwise, you're just making things hard for yourself and possibly introducing new bugs into the code.

There are even some cases where the hourglass cursor might be entirely appropriate. I mentioned earlier the $\frac{1}{10}$ second rule. Well, loading a large file into memory often takes longer than $\frac{1}{10}$ of a second. Does this mean that file-loading routines should be implemented in separate threads? Not necessarily. When a user commands a program to open a file, he or she usually wants that operation to be carried out immediately. Putting the file-loading routines in a separate thread simply adds overhead. It's just not worthwhile, even if you want to boast to your friends that you write multithreaded programs!

So think about approaching these things in a rational way, and in the next issue we'll begin looking at the Windows NT function calls involved in creating a multithreaded program. □

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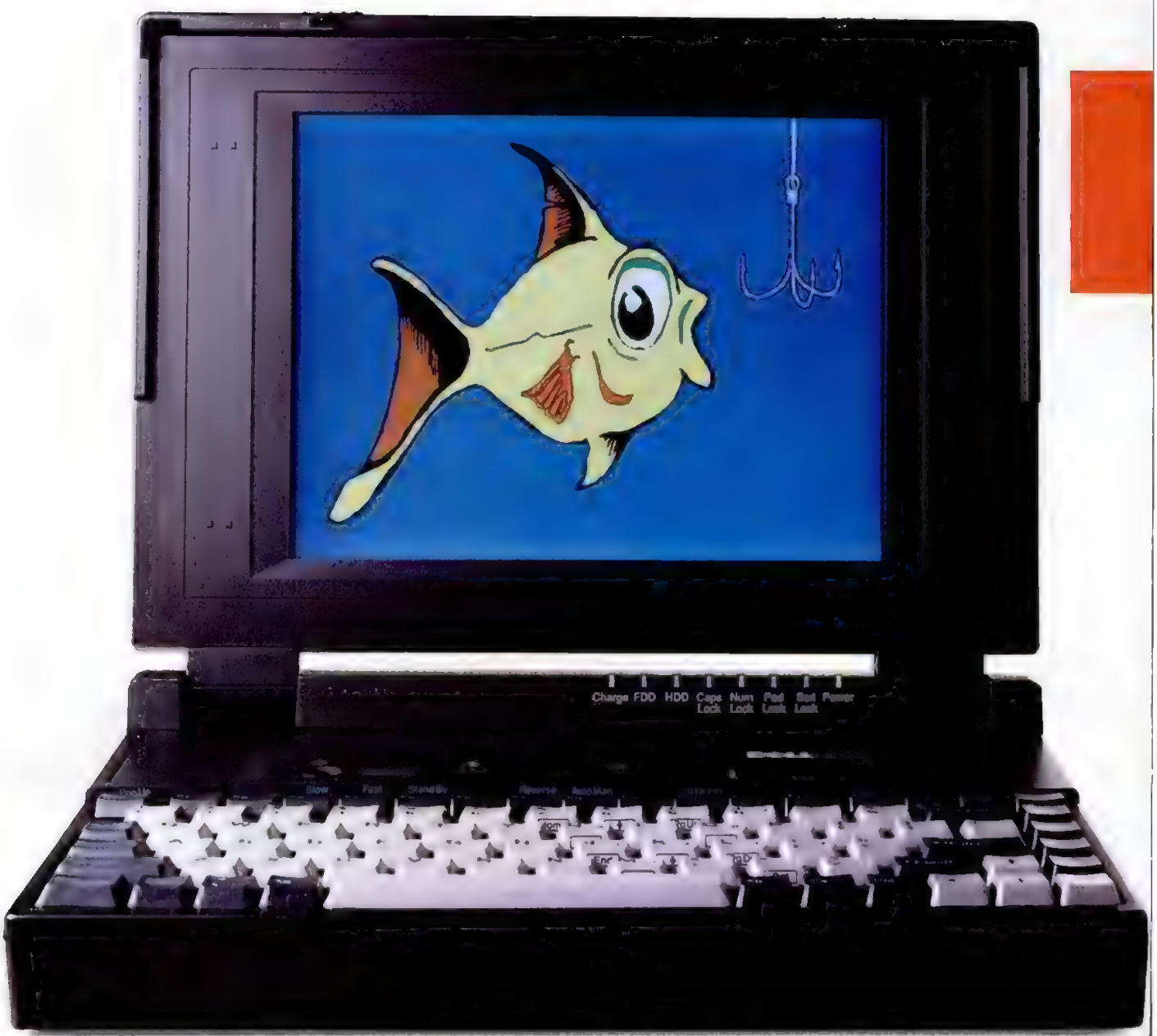

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How to Implement Context-Sensitive Help

BY RAY DUNCAN

As graphical user interfaces have become the standard, and on-line documentation has become a mandatory component of commercial software, developers have looked around for new ways to differentiate their products from those of their competitors. One of the more recent and clever innovations in the area of on-line help is *context sensitivity*. A software product with this feature responds to the user's request for assistance according to what the user is currently doing, instead of simply displaying the help file's main table of contents and expecting the user to navigate to the appropriate topic. For example, if the user presses the F1 key while the Save As dialog box is on the screen, the application will jump directly to a help screen that explains the constraints on filenames, how to change directories within the dialog, and so on.

When you first consider adding context help to your own program, you'll probably guess (as I did) that a first approach to solving the problem is simply keeping track of the mouse pointer and responding to WM_CHAR or WM_KEYxxx messages based on that position. However, a few moments of additional musing on the common Windows user interface widgets will quickly convince you that the problem must actually be more complicated. For example, the grunt work of displaying a menu pop-up on the screen, tracking the mouse within the pop-up, highlighting the menu item under the mouse pointer, and decoding the user's menu selection is all taken care of magically by USER.EXE; from the application's point of view, all it knows is that it gets a WM_INITMENU message before the menu is displayed and a WM_COMMAND message after the user has made a selection. Dialog handling, which allows for arbitrary combinations and groupings of controls, is even more magical.

As it turns out, there's more than one way to solve the context-sensitivity help problem. Windows is an exceedingly rich, complex environment, and the programmer who really wants to peek inside the environment's handling of menus and dialogs can find several ways to subvert these ordinarily atomic operations. The approved method, however, is for the application to register a Windows *hook*. A hook is nothing more than a callback procedure within the application that is entered by Windows when certain events occur; the application can filter the events by ignoring them, altering them, consuming them, or responding to them as it sees fit. Many classes of Windows applications, ranging from word processors to testing programs to debuggers, rely on the Windows support for hook procedures.

The multistep process of adding context-sensitive help to your Windows applications is described and illustrated with sample code.

Before we go any farther, I should mention that there are two parallel APIs in Windows for the installation, processing, and deinstallation of Windows hooks. The Microsoft manuals and SDK example programs all focus on the older API, consisting of SetWindowsHook(), UnhookWindowsHook(), and DefHookProc(). However, in this column, I'm only going to demonstrate the use of the hook API functions that first appeared in Windows 3.1—SetWindowsHookEx(), UnhookWindowsHookEx(), and CallNextHookEx(). The newer functions have a much cleaner design and have the additional advantage that they are symmetric with the hook functions in the WIN32 API.

CONTEXT-SENSITIVE HELP Adding any form of context-sensitive help to your application is a multistep process where all the elements must be coordinated and work smoothly together. In this column, I'm only going to show you how to implement an extremely simplistic form of context-sensitive help to a Windows program. If you've used elaborate on-line help systems such as the one in Microsoft Excel 4.0, you can imagine that the code in such a program devoted to context-sensitive help alone might well outweigh the totality of the applications written by us humbler developers! I'll leave such sophisticated implementations to your own creativity and experimentation.

Assume that we are starting with a working but vanilla Windows application that has a Help pop-up on its menu bar and an accelerator table that equates the F1 key to the Help Contents menu item. When the user picks the Help Contents menu item or presses the F1 key, the application launches WINHELP.EXE with the name of its help file to display the help table of contents. We want to modify the application so that if the user presses the F1 key while a pop-up menu is active, the help viewer displays the help topic that describes the application's menu selections rather than the usual table of contents. We can reach this goal by installing a windows hook function that sees every message generated by the

user's interaction with the application. The hook function will monitor for an F1 keystroke while a menu is active and will react to the keystroke by sending a special message to the application's main message handler. The main message handler will then activate the help viewer and steer it to the appropriate topic.

The first step in the implementation of this simple context-sensitive help is to prepare the help file. For those occasions when we want to display a specific topic rather than the table of contents, we must give the viewer a way to associate integer values passed by the application in a WinHelp() call with the context strings that are used internally to the help file as the targets of hyperlinks. This association is accomplished by adding entries to the [MAP] section of the help project (.HPJ) file that controls the compilation of the ultimate help (.HLP) file. For example, imagine that we are building the file EXELOOK.HLP that contains the online documentation for the program EXELOOK.EXE. To assign the integer identifier 1 to the EXELOOK.HLP topic labeled by the context string menu_index, we would edit the following lines into the EXELOOK.HPJ file:

```
[MAP]
menu_index 1
```

and then rebuild the EXELOOK.HLP file with the command: HC EXELOOK. The next steps would be to add code to the initialization sequence of the application to register a private window message for use by the hook function with RegisterWindowMessage(), then allocate a thunk address for the hook procedure with MakeProcInstance(), and install the hook function with SetWindowsHookEx(). One of the parameters for SetWindowsHookEx() is a code that determines what type of events will be passed to the hook procedure; in this case, we'd use the code WH_MSGFILTER, which means we want our hook procedure to be notified for every message that is related to our application but not for any other type of "hookable" event. SetWindowsHookEx() returns a *hook handle* that must be stored in a global variable for later use. Of course, code must also be added to the program's cleanup sequence to remove the hook procedure from the chain of all such callbacks by calling UnhookWindowsHookEx() with the hook handle, and (optionally) to release the thunk address with FreeProcInstance().

Now we must write the hook callback procedure itself, using the guidelines in the Windows API function reference for the particular type of event filtering that our procedure is going to perform. A hook procedure is always called back by Windows with three parameters: an integer referred to as nCode that classifies the event, a 16-bit value whose meaning depends on the event type, and a 32-bit value whose significance also depends on the event type. In the case of message

Source Code Skeleton for Context-Sensitive Help

1 of 2

```
// Skeleton code for context-sensitive Help
// in a Windows 3.1 application.
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// string used to allocate private message number
// for use by application's windows hook callback
#define HOOKMSGSTRING "HelpHookMessage"

// context ID for context-sensitive help. must be
// synchronized with the [MAP] section of HPJ file.
#define MENU_INDEX_HELP   1

// far pointer to windows hook callback
WNDPROC lpfnWindowsHookProc;

// handle for frame window
HWND hwndFrame = NULL;

// program instance handle
HANDLE hInst;

// handle for Windows hook function
HHOOK hWindowsHook;

//
// Table of window messages supported by FrameWndProc()
// and the functions which correspond to each message.
// The first slot is filled in with a private message number
// by InitInstance().
//
struct decodeWord messages[] = {
    0, DoHelpContext,
    WM_CREATE, DoCreate,
    WM_INITMENU, DoInitMenu,
    WM_SIZE, DoSize,
    WM_COMMAND, DoCommand,
    WM_CLOSE, DoClose,
    WM_DESTROY, DoDestroy, } ;

    .
    .
    .

//
// WinMain() is the usual application entry point
//
INT APIENTRY WinMain(HANDLE hInstance, HANDLE hPrevInstance,
                     LPSTR lpszCmdLine, INT nCmdShow)
{

// save instance handle
hInst = hInstance;

// If this is the first instance of the application,
// register window classes, or exit
if(!hPrevInstance)
{
    if (!InitApp())
        return(FALSE);
}

// Create the frame and do other instance-specific
// initialization, or exit
if(!InitInstance(lpszCmdLine, nCmdShow))
    return(FALSE);

while(GetMessage(&msg, NULL, 0, 0)) // while msg != WM_QUIT
{
    TranslateMessage(&msg);         // translate virt keys
    DispatchMessage(&msg);          // dispatch message
}

    // clean up all allocations
    TermInstance();
}

//
// InitInstance() -- Performs a per-instance initialization
// of application, creating the frame window, allocating
// private messages, etc.  Returns TRUE if initialization
// successful, FALSE otherwise.
//
BOOL InitInstance(LPSTR lpCmdLine, UINT nCmdShow)
{
    .
    .
    .

    // allocate private message number for use by
    // windows hook callback procedure
    messages[0].Code =
        RegisterWindowMessage((LPSTR) HOOKMSGSTRING);

    if(messages[0].Code == 0)
        return(FALSE);

    // allocate thunk for windows hook callback
    lpfnWindowsHookProc =
        MakeProcInstance((WNDPROC) WindowsHookProc, hInst);
```

Figure 1: **This code outlines the procedures for implementing context-sensitive help in your Windows applications.**

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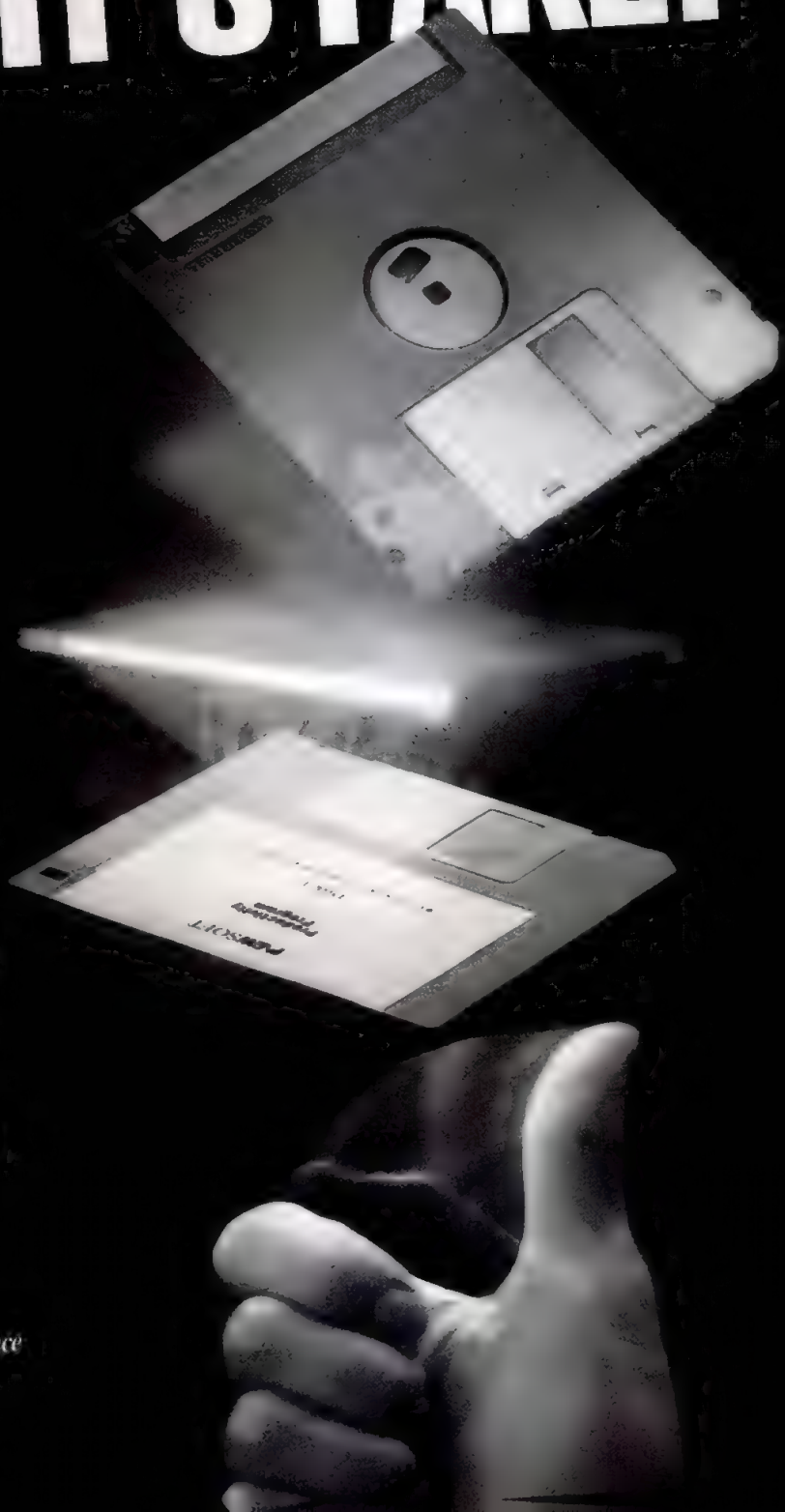

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Source Code Skeleton for Context-Sensitive Help

2 of 2

```
    // bail out if thunk allocation failed
    if(lpfnWindowsHookProc == NULL)
        return(FALSE);

    // register windows hook callback and save handle
    hWindowsHook =
        SetWindowsHookEx(WH_MSGFILTER, lpfnWindowsHookProc,
                         hInst, GetCurrentTask());
    .
    .
    .

    return(TRUE);
}

//
// TermInstance() -- global cleanup for application instance.
//
BOOL TermInstance(VOID)
{
    .
    .
    .

    // delete our windows hook function from global chain
    UnhookWindowsHookEx(hWindowsHook);

    // release the thunk for our windows callback
    FreeProcInstance(lpfnWindowsHookProc);

    return(TRUE);
}

//
// FrameWndProc() receives all messages for the frame window.
// It looks up the new message in the table messages[] and
// dispatches the appropriate routine if a match is found,
// otherwise it calls DefWindowProc().
//
LONG FAR PASCAL FrameWndProc(HWND hWnd, UINT wMsg,
    UINT wParam, LONG lParam)
{
    INT i;

    for(i = 0; i < dim(messages); i++)
    {
        if(wMsg == messages[i].Code)
            return((*messages[i].Fxn)(hWnd, wMsg, wParam, lParam));
    }

    return(DefWindowProc(hWnd, wMsg, wParam, lParam));
}

    .
    .
    .

//
// DoHelpContext() -- this routine is called by
// FrameWndProc() for processing of the private message
// sent by the windows hook procedure.  It
// invokes the help file viewer with a context ID
// in order to deliver context-specific help.
//
static LONG DoHelpContext(HWND hWnd, UINT wMsg,
    UINT wParam, LONG lParam)
{
    WinHelp(hWnd, szHelpFileName, HELP_CONTEXT, MENU_INDEX_HELP);
    return(FALSE);
}

//
// WindowsHookProc -- windows hook callback function.
// This function must be registered with SetWindowsHookEx()
// and exported in the application DEF file.
//
DWORD FAR PASCAL WindowsHookProc(INT nCode, UINT wParam, LPMSG lpMsg)
{
    // bail out if callback unknown type or if pointer
    // to message structure is not valid
    if((nCode < 0) || !lpMsg)
        return(CallNextHookEx(hWindowsHook, nCode, wParam, lpMsg));

    // check if this is F1 keypress during a menu popup
    if(nCode == MSGF_MENU)
        if((lpMsg->message==WM_KEYDOWN) &&
           (lpMsg->wParam == VK_F1))
        {
            // yes, post private message number to
            // our frame window's message handler
            PostMessage(hwndFrame, messages[0].Code,
                        nCode, lpMsg->hwnd);
        }

    // pass message on to the other windows hooks proce in chain
    return(CallNextHookEx(hWindowsHook, nCode, wParam, lpMsg));
}
```

events, nCode specifies whether a menu or dialog is active, the other 16-bit value is unused, and the 32-bit value is a far pointer to the msg[] structure containing (among other things) the familiar values hWnd, wMsg, wParam, and lParam. We design our hook procedure to test nCode for the value MSGF_MENU, then access the msg[] structure via the 32-bit pointer and check for the message type WM_KEYDOWN and the virtual key value for the F1 key.

If all these conditions are met, we call PostMessage() with the private message number that was previously obtained from RegisterWindowMessage(). (Calls to SendMessage() should be avoided in hook functions because they can result in deadlock conditions.) Finally, we pass the event to the next Windows hook procedure in the chain by calling CallNextHookEx().

We're almost done now. We only need to add some lines of code to the message handler for our application's main window that will detect the private message number posted by the callback procedure. To process this message, we call WinHelp() with the command HELP_CONTEXT, the pathname for the help file, and the identifier that was associated with the context string for the menu topic in the [MAP] section of the HPJ file. The effect of this call is to launch WINHELP .EXE, if it isn't already running, and the menu topic is displayed in the main viewer window. The skeleton for all this context-sensitive help code can be found in Figure 1, and the source code for a version of EXELOOK.EXE that supports context-sensitive help can be downloaded from PC MagNet.

The final step is to export the windows hook procedure by adding its name to the EXPORTS section of the application's module definition (.DEF) file, and then rebuild the application.

READER FEEDBACK Many of you have written about my columns on Windows NT and the Windows help system. I've selected a few letters to publish here.

I appreciate your mentioning simtel in your April 13, 1993, article in PC Magazine *(titled "The Hazards of Exploring Evolving Environments"), but many users are likely to find the TOPS-20 file system daunting. Similarly, garbo is not a U.S. site, and access to it can be finicky. You might want to direct readers to the mirror site at Washington University in St. Louis, wuarchive.wustl.edu. The wuarchive.wustl.edu site mirrors not only simtel but a huge number of other sites, offering a wealth of programs. The MS-DOS partition from simtel is echoed in /mirrors/msdos. There are also MS-DOS archives located at archive.msdos.umich .edu.*

You might also wish to mention to users who don't have direct Internet access that a mail-based FTP (file transfer protocol) server, BITFTP, exists at Princeton University and can be reached via e-mail at BITFTP@PUCC.EDU; sending the command HELP in the body of an e-mail

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message will return instructions to you on how to use the BITFTP service.

David O'Donnell
via Internet

In your April 13, 1993, column, you give some erroneous advice.

First, the instructions you supplied to use anonymous FTP to retrieve .ZIP files from the simtel20 archive will result in the mangling of whatever file is being downloaded. The simtel20 is one of the few anonymous FTP archives where the magic word for setting the file type for transfer is not *"binary." On simtel20 the file type* must *be declared as "tenex." The reasons for this are moderately arcane but there is no way around it.*

Secondly, you point to garbo.uwasa.fi as a popular mirror of the simtel20 site. The garbo.uwasa.fi site does have many of the same files as the simtel20 archive, but it is not a mirror site; it does not have all the same files and it does not have the same directory structure. In addition, if the majority of the PC Magazine *readership is in the U.S., steering readers to an archive site in Finland could result in costly international transfers.*

Two sites that are mirrors of the simtel20 archive are oak.oakland.edu and wuarchive.wustl.edu, and both are in North America.

John Schmid
via Internet

WINDOWS HELP *I'm glad to see someone spreading the word that Windows contains an excellent built-in viewing tool for on-line Help.*

It's unfortunate that the SDK documents the common-enough but arcane RTF file format the way it does. Microsoft could have made things much easier by documenting the Windows help authoring system in the SDK the same way it documents the multimedia viewer for the MDK (Multimedia Development Kit). The multimedia viewer (that Microsoft uses, with some extensions, for such projects as CineMania) is, after all, just a superset of the WinHelp development environment. (I suspect that Microsoft is trying to keep this a secret, and that we will see multimedia viewer as the on-line help viewing engine in future versions of Windows.)

In case you didn't know, there's an update to HC31.EXE posted on Microsoft's BBS. It's named HCP.EXE, dated April 17, 1992, and uses XMS so you can compile larger help files without the risk of getting out-of-memory errors. [This program is also available in the Microsoft Library Forum on CompuServe.—R.D.]

I hope your articles promote better on-line help. But frankly, I don't think we're going to see significant improvement until the development community acknowledges that on-line help files are technical documents just like printed manuals and, as such, should be written by the technical documentation department, not programmers whose primary responsibility needs to be with the code.

Wayne Hausmann
via Internet

Thanks for your recent article in the May 11, 1993, issue of PC Magazine. *I built my first Windows help application using WordPerfect for Windows, Version 5.2. I encountered some differences between the two word processors when I tried to map your Microsoft Word examples into working text:*

- *WordPerfect for Windows handily exports and imports text in RTF format. This seems to indicate that only one copy of a help file needs to be maintained; that the RTF format can be edited directly, and the native WordPerfect format can be forgotten. However, I have experienced loss of some formatting codes when importing RTF documents into the editor. Therefore I will still abide by your suggestion of editing in one format and exporting to the other.*
- *The # symbol may not be used to number footnotes unless the Layout/Footnote/Options/Numbering Method is set to* character. *Then a string of valid characters must be specified in the Layout/Footnote/Options/Characters field. For instance, the string "#*$K+" would allow you to specify context strings (#) as well as build tags, titles, keywords, and browse sequence numbers.*
- *Use Tools/Comment/Create in WordPerfect for Windows to insert invisible text for hypertext links. Unfortunately, WordPerfect for Windows inserts leading and trailing carriage returns around the comment and highlights it with a shadow box; despite its ungainly appearance, this works. The strikeout and redline font styles are interpreted as visible text, and they are not suitable for hypertext links.*

James McNamara
via Internet

The help authoring support tools in the MSDN CD-ROM that you mention in your first help file article (April 27, 1993) are now available on the Internet. The help compiler for 3.0 and 3.1 along with WHPE (Windows Help Project Editor), the WinWord macros, and other goodies can be found on ftp.cica.indiana.edu in /pub/pc/win3/uploads/what.zip (a 1.5MB file). The Windows Help Authoring Guide is on the same machine: /pub/pc/win3/programr/whag.zip contains this guide in WinWord documents, and /pub/pc/win3/programr/hag.zip contains the guide in the Help format. Each file is approximately 500K.

Tim King
via Internet

Clearly, there's a dearth of information about WinHelp. Which brings me to a plug for a book I coauthored along with Dave Farkas and Joe Welinske: Developing Online Help for Windows. *It is published by Howard W. Sams Co.*

While the Windows Help Authoring Guide does contain a ton of valuable information, it's not very process-oriented. For example, Microsoft gives the macro syntax, but doesn't really explain where to use macros, or the intricacies of doing something like dynamically changing the button binding in a help system.

In our book, we included more how-to information, a large section on help design principles, complete SDK-like documentation, a look at development methodologies, and reviews of the automated help tools currently on the market. For more info, see the WinHelp Forum on CIS for a help file containing a full outline and chapter summaries.

Scott Boggan
via CompuServe

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TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

PCs

KEEPING YOUR CMOS INFORMATION HANDY

TIP It's certainly a good idea to keep a copy of your CMOS setup information, but writing it all down by hand is a horrible job, especially if you have a BIOS with two or three screens of data. I've found a simple way to print this information in an easy-to-read format.

The Print Screen function is part of a computer's motherboard BIOS and does not depend on DOS or any other operating system or software. This means that it's already active when your computer displays the CMOS configuration screens during boot-up. Just hook up a printer to your LPT1 port, press Shift-PrtScr, and you'll be able to print your CMOS setup information.

I always make two copies. I tape one inside the computer case and file the other. Now if the CMOS gets scrambled, I can quickly restore it to its original settings.

Sid Kingdon
Northbrook, Illinois

▶**PC MAGAZINE:** Sometimes the most elegant tips are the simplest—this one is a great time-saver, too. I've tested it on a number of systems, and it worked with all of them. This doesn't mean it's conclusive, but the chances for success are so good that I think you should take the time to print out your CMOS settings the next time you power up.

The only setting screens I couldn't print were the pop-up screens on a Toshiba laptop, but the rest of the setup information printed just fine.

One point worth noting is that you don't need to hold down the Shift key with PrtScr on most keyboards. The older XT and AT style keyboards required a shifted PrtScr, but most 101-key keyboards work without it.

In addition, your printer must be able to accept an ASCII print stream. If you use a PostScript printer, you'll have to put it in an emulation mode like that of an HP LaserJet; if it doesn't offer any compatibility modes, your only solution will be to find another printer. Also, if you're using a laser printer and your BIOS has more than two screens of information, you'll probably find that it's a good idea to eject the page after every second Print Screen. With a default Courier font, you typically get 60 printed lines per page, and with 25 lines of data per screen, two screens will fit on a page. A third screen would split across pages, however, so it will be easier to read the information if you start it on a page of its own.

See "Hidden Problems with Scrambled CMOS," which appeared in the April 27, 1993, Solutions column, for another valuable tip concerning your CMOS configuration memory.

—Alfred Poor

TAKING CARE OF YOUR PC

❓ Can you tell me what I should do in the way of basic preventive maintenance for my computer system? I found out the hard way that the internal clock battery must be changed when a lithium battery corroded and ruined my old IBM XT's motherboard. Are there other components I should keep an eye on? Is there a way to know whether or not the power supply is going bad?

Patricia Hardy
New York, New York

▶**PC MAGAZINE:** There is surprisingly little to do in the way of preventive maintenance for desktop computers. While it's true that batteries, power supplies, and

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PC DIRECT starts here—with exciting offers from top direct vendors.

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other components will eventually fail, most such equipment failures are quite rare and are so difficult to predict that it probably isn't worth your time to try to figure them out.

The exception to this general rule is the internal battery. It is relatively inexpensive, and replacing it on a regular basis will probably cause you less trouble than waiting for it to fail will. And by scheduling the change, you get to deal with the task on your own terms, rather than having to respond to a crisis when the battery finally gives out. Remember, when you remove your old battery you lose the contents of your CMOS configuration memory, and it's important that you restore *all* the correct settings after you replace the battery. See "Keeping Your CMOS Information Handy" above for more information on this topic.

I've had batteries last for three years or longer, but if you want to be conservative, you could change your battery as frequently as every other year. If you have several computers, you can simply arrange to change all the batteries at the same time. This is also a good time to update inventory records, make copies of the configuration files, and audit the installed software. (Your company does have a policy for auditing software use, doesn't it?)

There is one important preventive maintenance task that you should perform at least once a year, or even more frequently depending on your working conditions. The biggest enemies of your computer's innards are dirty power and heat. You need to prevent power problems with surge protectors, voltage regulators, and standby power supplies. The heat problem, however, is best addressed by periodic cleaning inside the computer's case. The air flow caused by the cooling fans can cause dust to accumulate on the motherboard, coating the chips with a heat-retaining blanket, which in turn causes the chips to run hotter, increasing the risk of failure. The problem is especially severe in offices where there are heavy smokers, as smoke particles can accumulate rapidly inside computers.

A hand-held vacuum cleaner is ideal for cleaning your computer, especially one with a flexible extension tube and a brush on the end. Pay special attention to all vent louvers on the case as well as on the motherboard itself, as these are areas where large amounts of dust can pile up. A regularly scheduled inspection can also prevent other forms of damage.
—*Alfred Poor*

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Peripherals

FASTER GRAPHICS PRINTING ON A LASERJET

❓ The "Speeding Up Windows Printing" sidebar in "Mainstream Lasers: Getting Better All the Time" (November 24, 1992) refers to "the video input/output port found on the back panel of the Hewlett-Packard LaserJet II, IID, III, and IIID." I have an HP LaserJet III and can't find anything marked as a video jack, nor can I find any reference to a video interface in any of the manuals. Since I work with multimedia, I'd like to print images from videotape or interface with video another way. Where is this video port, and what can it do for me?

Dave Saunders
Thousand Oaks, California

▶**PC MAGAZINE:** No, your LaserJet didn't miss a stage on the assembly line; you won't find anything labeled *video port* on your printer.

The sidebar is referring to the slot for an optional interface located behind a panel on the printers listed above. This slot gives designers direct access to the printer's controller, instead of having to pipe data through a serial or parallel port.

Serial port transmissions are slower than parallel port transfers, but when dealing with the huge volumes of data required to define some graphics printouts, even parallel ports aren't fast enough. A parallel port handles about 10K to 12K of data per second, so it could take a couple of minutes to transfer an image larger than 1MB.

Since images at 600 dpi (dots per inch) can require as much as 45K per square inch (600*600/8*1,000 = 45) and there are more than 80 square inches (8*10 = 80) on a standard letter-size page, it's common to have graphics pages that require more than 1MB to define them.

To speed the transfer of this image data from the computer to the printer, some designers have resorted to a *video interface* that uses a video-like signal to push the data through to the printer's controller faster than a parallel port could do it. This requires an expansion card in the computer and a small adapter card in the interface slot of the printer.

This slot is sometimes used for printer sharing devices and fax receiving modules, but it's most often used for video interfaces in order to achieve faster data transfer. That's why people often refer to the slot as a video interface port.

Note that printer manufacturers have started to pursue other solutions to data transfer. HP put a *bitronics* parallel port on its LaserJet 4, which can transfer data ten times as fast as the standard Centronic parallel port found on older printers.

Unfortunately, this means you won't be able to plug your VCR into your LaserJet to print out images. To do this, you would need a frame-grabber card, which can capture frames of video images and save them as a graphic file on your computer's disk. You could then print the image as you would any other graphic.
—*Alfred Poor*

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CIRCLE 347 ON READER SERVICE CARD

Operating Environments

RELOCATING TASKMAN'S DIALOG BOX IN WINDOWS

TIP If you find it inconvenient that the Windows 3.1 Task Manager always appears in the middle of the screen when you press Ctrl-Esc, here's how you can place it anywhere you like. Adding the following line:

```
TASKMAN.EXE=TASKMAN.EXE 1000 1
```

to the [boot] section of SYSTEM.INI tells Windows to put TASKMAN's dialog box in the upper-right corner of the screen. The Windows documentation doesn't tell you anything about that.

The numbers at the end of the line represent the *x* and *y* position of TASKMAN on the screen. Windows won't place TASKMAN off the screen, so the value of 1,000 for *x* puts TASKMAN in

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the upper-right corner, even though I don't know the exact *x* location. You can position TASKMAN in the upper-left corner of the screen by using the coordinates 1, 1.

Here's another tip I think you'll find useful: By default, when TASKMAN tiles just a few windows on the desktop it makes them tall and skinny and arranges them from left to right. If you hold down the Shift key when you click the Tile button, TASKMAN will instead make the windows short and wide, arranging them from top to bottom.

Eddie Lee
Richmond, British Columbia, Canada

▶PC MAGAZINE: In most cases, Microsoft's *Windows Resource Kit* (WRK) explicates details of Windows usage that the *User's Guide* doesn't, but this is a rare exception. The WRK does point out that in Windows 3.1 you can specify which program will run as task manager. The value of the TASKMAN.EXE= key in the [boot] section of SYSTEM.INI determines what program will run when you press Ctrl-Esc, double-click on the desktop, or select Switch from a program's system menu. You can actually substitute another program of your choice by changing this line.

If you execute TASKMAN.EXE directly from Program Manager's File | Run menu option, you can place its window precisely at any desired *x*- and *y*-coordinates. For example, `TASKMAN 200 100` will place the window at a location 200 pixels right and 100 pixels down from the upper-left corner of the screen. But when you specify the coordinates in SYSTEM.INI, only the *x* value takes effect. The TASKMAN window will always appear at the top or bottom of the screen.

Note also that specifying coordinates in SYSTEM.INI affects the way TASKMAN comes up when you double-click on the desktop. Normally the window appears near the spot where you double-clicked. When coordinates are specified in SYSTEM.INI, the window appears at the specified *x* location, either at the top or bottom of the screen.

—Neil J. Rubenking

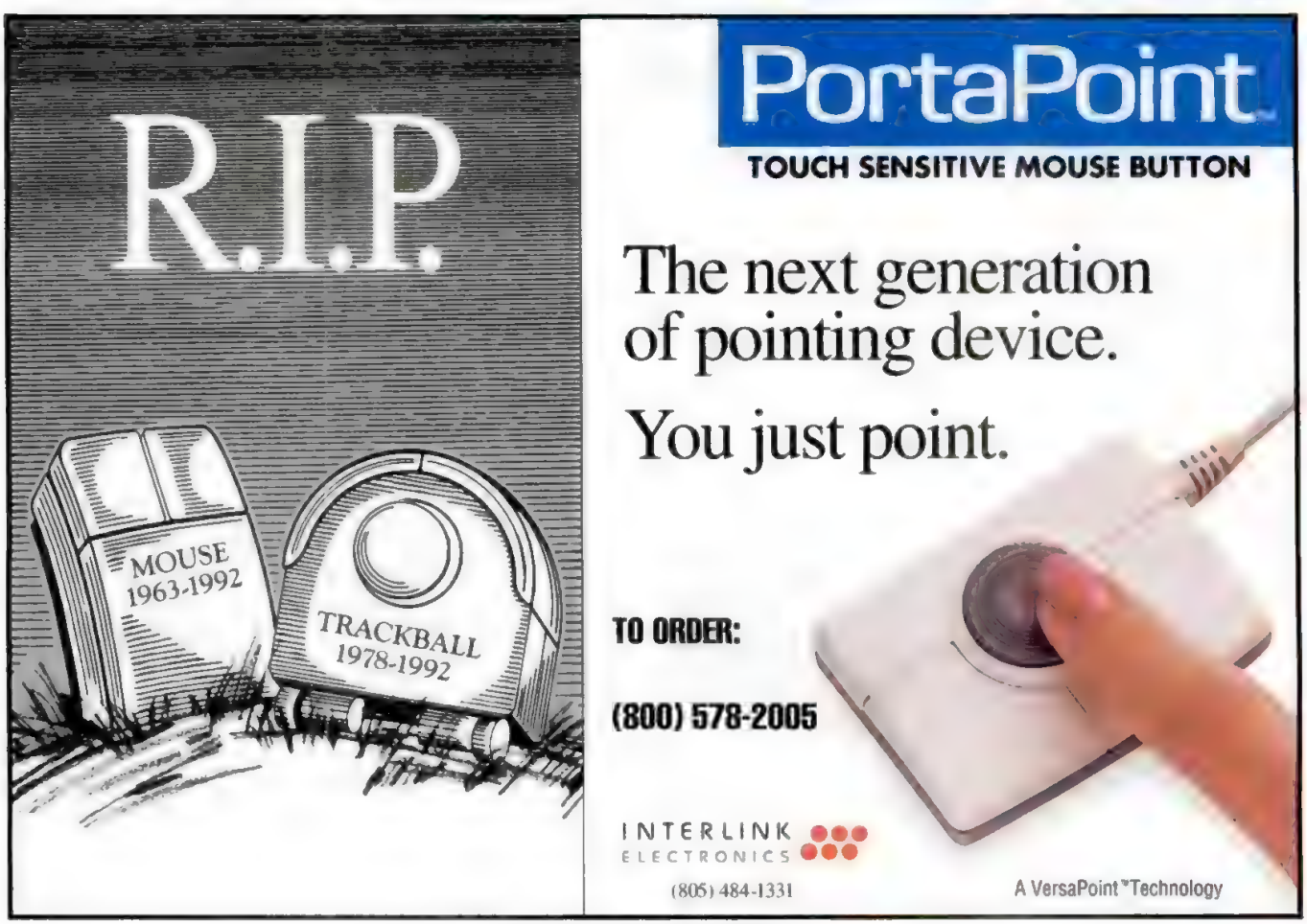
SAVING RAM DISK FILES WHEN EXITING WINDOWS

❓ I have a 386/25 with 8MB of RAM, and I use Microsoft Windows 3.1 and its applications almost exclusively on my system. Because my hard disk is rather slow, I'd like to use a RAM disk for some of my work in Word for Windows and Aldus Persuasion for Windows. The problem with doing this is that, inevitably, when I turn off my computer I forget to save the files from the RAM disk to the hard disk.

Somehow I'd like to create a procedure that automatically saves the files on my RAM disk to my hard disk when I exit Windows. Do you have any suggestions for doing this?

Jim Ruiz
Miami, Florida

▶PC MAGAZINE: The easiest way to accomplish this is to run Windows 3.1 from a batch file and include the lines that copy RAM disk files to the hard disk right in



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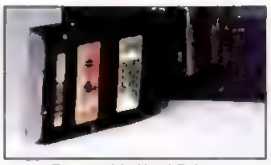

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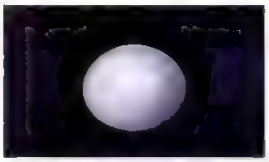

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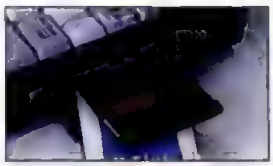

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CIRCLE 235 ON READER SERVICE CARD

SHUTDN.PAS

Complete Listing

```
{$A+,B-,D-,F-,G-,I-,K-,L-,N-,P-,Q-,R-,S-,T-,V+,W+,X+,Y-}
PROGRAM ShutDn;
Uses WinTypes, WinProcs, WinDOS, Strings,
{$IFDEF Ver7$} OWindows; {$ELSE} WObjects; {$ENDIF}
{$R ShutDn}
{$D ShutDown - Copyright (c) 1993 by Neil J. Rubenking}

CONST AppName : PChar = 'ShutDown';
TYPE
  TMyApplication = OBJECT(TApplication)
    PROCEDURE InitMainWindow; virtual;
  END;

  PTestWindow = ^TTestWindow;
  TTestWindow = OBJECT(TWindow)
    DidShutDown : Boolean;
    FUNCTION GetClassName : PChar; Virtual;
    PROCEDURE GetWindowClass(var AWndClass: TWndClass); Virtual;
    PROCEDURE wmQueryOpen(VAR Msg : TMessage); Virtual
      wm_First + wm_QueryOpen;
    FUNCTION CanClose : Boolean; Virtual;
    PROCEDURE wmQueryEndSession(VAR Msg : TMessage);
      Virtual wm_First + wm_QueryEndSession;
  END;

  FUNCTION TTestWindow.GetClassName;
  BEGIN GetClassName := AppName; END;

  PROCEDURE TTestWindow.GetWindowClass(VAR AWndClass : TWndClass);
  BEGIN
    TWindow.GetWindowClass(AWndClass);
    AWndClass.hIcon := LoadIcon(HInstance, AppName);
    DidShutDown := FALSE;
  END;

  PROCEDURE TTestWindow.wmQueryOpen(VAR Msg : TMessage);
  BEGIN Msg.Result := 0; END;

  FUNCTION TTestWindow.CanClose : Boolean;
  BEGIN
    CanClose := MessageBox(hWindow, 'ShutDown should remain active '+
      'until Windows shuts down.  Terminate it anyway?',
      'ShutDown Message', mb_YesNo + mb_IconQuestion) = idYes;
  END;

  PROCEDURE TTestWindow.wmQueryEndSession(VAR Msg : TMessage);
  VAR
    CommandLine : ARRAY[0..144] OF Char;
    InstanceID  : THandle;
  BEGIN
    IF NOT DidShutDown THEN
      BEGIN
        MessageBox(hWindow, 'Running SHUTDOWN.BAT.  When it '+
          'finishes, exit Windows again', 'ShutDown Message',
          mb_Ok + mb_IconInformation);
        Msg.Result := 0;
        StrCopy(CommandLine, GetEnvVar('COMSPEC'));
        StrCat(CommandLine, ' /C SHUTDOWN.BAT');
        WinExec(CommandLine, sw_ShowNormal);
        DidShutDown := TRUE;
      END
    ELSE DefWndProc(Msg);
  END;

  PROCEDURE TMyApplication.InitMainWindow;
  BEGIN
    MainWindow := New(PTestWindow, Init(Nil, AppName));
  END;

VAR MyApp: TMyApplication;
BEGIN
  cmdShow := SW_ShowMinimized;
  MyApp.Init(AppName);
  MyApp.Run;
  MyApp.Done;
END.
```

Figure 1: **This program automatically runs a user-provided batch file called SHUTDOWN.BAT when you exit Windows.**

the batch file. For example, if your RAM disk is drive G: and its files are normally stored in the directory C:\RAMDISK, your batch file might look something like this:

```
@ECHO OFF
XCOPY C:\RAMDISK G:\ /S
WIN
XCOPY G:\ C:\RAMDISK /S
```

It is possible, however, to perform special shutdown tasks during the Windows shutdown process. When you choose to exit Windows, every running application gets a warning message called WM_QUERYENDSESSION. This gives the application a chance to prompt the user to save changed data, for example. Also, an application's response to the WM_QUERYENDSESSION message can prevent Windows from shutting down.

I wrote a tiny program, SHUTDN.PAS, in Borland Pascal for Windows that responds to this message by running a batch file called SHUTDOWN.BAT. This response is triggered only once, so after SHUTDOWN.BAT runs you can exit Windows normally; you don't have to understand programming to use it. Just download SHUTDN.ZIP from PC MagNet's Utilities/Tips Forum, the Sol:Win, DOS & OS/2 Library. Install it in your Startup group, and provide a SHUTDOWN.BAT file in a directory on your path. That's it!

For those who are interested, Figure 1 shows the SHUTDN source code. Because it's an Object Windows Library (OWL) program, it only needs to define program actions that are *different* from the default window behavior. SHUTDN returns 0 when it receives a WM_QUERYOPEN message, so it always remains iconic. It warns against terminating the program before Windows shuts down, but then allows termination after confirmation has been received. Most important, it responds to the WM_QUERYENDSESSION message by running the SHUTDOWN.BAT batch file. After running SHUTDOWN.BAT, the program sets an internal variable so that the next time it gets a WM_QUERYENDSESSION message, it will allow Windows to exit.

—Neil J. Rubenking

Word Processing

TIMED BACKUP IN WORDPERFECT

TIP If you take advantage of the automatic timed backups in WordPerfect 5.1, and your system crashes (or you lose power) while you're working in two documents, you'll find that when you load WordPerfect again, it asks if you want to delete or rename the backup—but only for document 1. This doesn't mean that document 2 is lost, however. You can still find it in either your WordPerfect directory or your designated directory for backup files. Look for the file called WP{WP}.BK2. You can rename it using DOS or WordPerfect commands, then use it as usual.

Raphael Chow
Mississauge, Ontario, Canada

▶PC MAGAZINE: It's actually a bit more complicated than that. If you have backup files on your disk for both docu-

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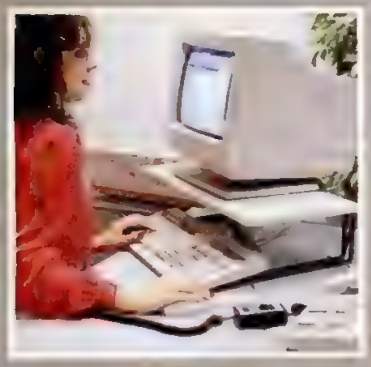

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ments 1 and 2 and are using an early release of 5.1, WordPerfect will wait for you to switch to document 2 before asking whether to rename the document 2 backup file.

However, current releases (starting with 12/31/90, according to WordPerfect) will ask about both documents 1 and 2 when you load the program. Version 5.0 won't ask whether to rename either document's backup file under any circumstances.

More important, when you're working on two documents, the timed backup doesn't back up both. If you're switching back and forth between documents, WordPerfect will only back up the one you're in when it's time to back up. And if you happen to be in the same document each time the backup comes around, it won't back up the other document at all. The moral is simple: If you're working on more than one document, don't count on the timed backup.—*M. David Stone*

KEEPING TRACK OF DOCUMENTS IN WP AND WORD

TIP WordPerfect 5.1 lets users work in two documents at once and allows you to switch between them with Shift-F3. This feature is particularly useful for copying information from one file to another, for adding material simultaneously to two files, or for looking at one part of a given document while working on another part of the same document—particularly if you want to move large sections of text from one part of the document to another. Unfortunately, working on two files can be confusing, and working on two versions of the same document can be disastrous. It's far too easy, for example, to delete a paragraph from the principal version of the document (the one you intend to keep) instead of from the work file. Of course, WordPerfect displays the filename in the lower-left corner and "Doc 1" or "Doc 2" in the lower-right corner, but it's still too easy to lose track of which file you're in.

Color provides a simple way to avoid confusion. WordPerfect 5.1 lets you set the screen attributes for Doc 1 and Doc 2 independently. To set colors, type Shift-F1 to go to Setup, then choose Display, Colors | Fonts | Attributes, Screen Colors. From here you can use Shift-F3 to toggle between the setting screens for Doc 1 and Doc 2. Leave Doc 1 set to the default values. But change the background color for Doc 2 by moving to the Background column for Normal text (the first Attribute), and typing in a letter to indicate the color you want to change to. (WordPerfect shows a list of letters at the top of the screen, with each letter appearing in the color it represents.)

Once you've selected a color, hit the F7 key twice to exit. Now when you switch from one document to the other, you'll have no doubt about which document you're in.

Terry A. Rustin
Houston, Texas

▶**PC MAGAZINE:** This technique will work in WordPerfect 5.0 as well as 5.1. One of the reasons it's worthwhile is that WordPerfect lets you open the same file twice, but then treats the two on-screen documents as two unrelated files. If you make changes in both files, and then save both under the same name, the changes in the last version saved will be preserved, but the other window's changes will be lost.

Microsoft Word for DOS users should note that using colors to identify documents can also be highly useful in their word processor—but for different reasons. Unlike WordPerfect, when Word opens more than one window on a given file, it treats the windows as different views of the same file. Make a change in one window, and it will show up in all the other windows for that file. And it doesn't matter which window you save a file from or what order you save the windows in. Any changes that you've made in any window will show up in the saved file.

When you open two or more files in Word at the same time, however, it's still easy to lose track of which file you're looking at. In fact, the confusion can be worse with Word than with WordPerfect, since you can open up to eight windows in Version 5.0 or up to nine in 5.5.

The strategy I've always favored in Word is to use the same color for all windows on a single file, but use different colors for different files. To change the color of a Word 5.0 window, choose Esc Options, then move to the Colors option, hit F1, and set the colors, much as you do in WordPerfect. To change the color of a Word 5.5 window, choose Utilities, Customize, Preferences, Colors, then set the colors in the Colors dialog box, choosing Window Background in the Things To Color text box, and the color you want in the Color Set options.

Regardless of which program you use, be sure that you don't pick a background color that will render a character color invisible; this goes for other character styles such as bold or italic, too.

Unlike WordPerfect, Word does not store the colors to use for each window for future editing sessions. This is just as well; if you follow this strategy, you will likely want different colors in specific windows at different times, depending on which files you've loaded, and in what order.

Setting the colors manually each time you need them, however, can be clumsy enough to discourage you from changing colors. A far better approach is to create a set of macros to let you easily set the colors as you need them for each window. In Word 5.0, the format for each macro looks like this:

```
«set echo="off"»<esc>o<right><down6>
<f1>X<enter>
```

where X is the letter that defines a given color—A for black, B for blue, C for green, D for cyan, and so on. In Word 5.5, the equivalent macro is

```
«set echo="off"»<Alt U>u<Alt E>C<Alt X>
<enter>
```

where X, once again, is the letter that defines a given color—A for black, B for blue, and so on.

To make the macros easy to remember, simply name each one to match the color it switches to—name a macro Blue for changing to blue, Black for changing to black, and so on. You can then change the color for any window by moving to that window with F1 in Word 5.0 or Ctrl-F6 in Version 5.5 (assuming it's set for 5.5 function keys), typing the name of the color you want, and hitting F3 to run the macro.—*M. David Stone*

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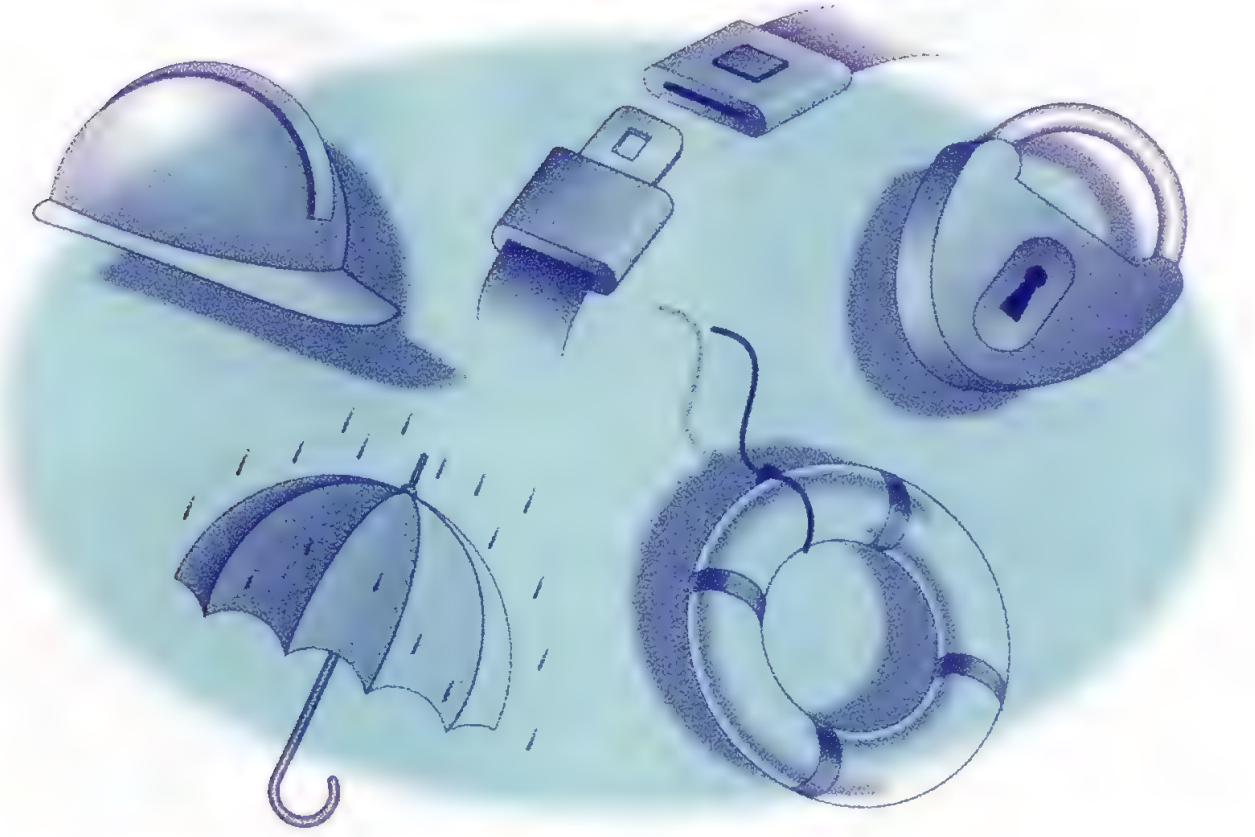

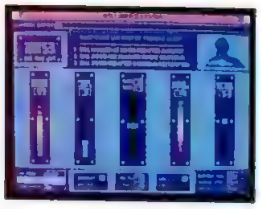

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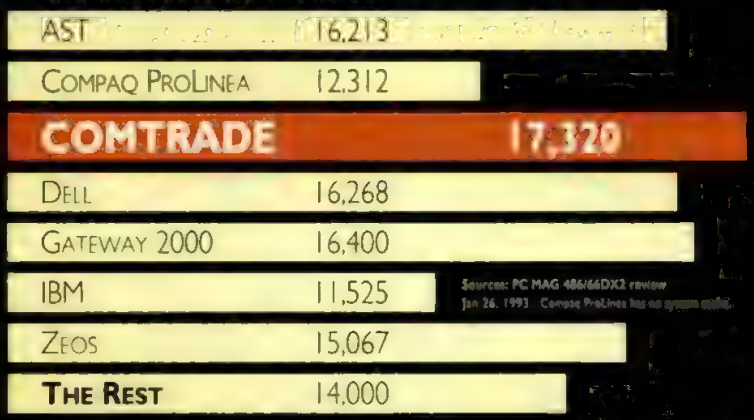

Sources: PC MAG 486/66DX2 review Jan 26, 1993 Compaq ProLinea has no system audio.

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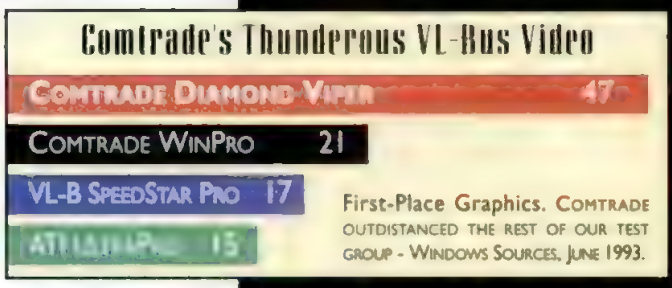

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Spreadsheets

ERROR BARS FOR EXCEL

TIP I read the Lotus 1-2-3 solution for producing error bars in your February 13, 1990, issue and would like to suggest a similar solution for Excel users.

The table in the top-left section of Figure 2 shows a set of data comparing pH changes over time in dental plaque following a sugar rinse.

Columns A and B contain the *x* and *y* data values, respectively. Columns C and D contain the *x*-values and the corresponding minimum and maximum values for error bars, respectively. For example, at time = 15 minutes, the pH was 5.45 plus or minus 0.15, resulting in a minimum error point of 5.30 and a maximum point of 5.60. In between each set of error points is a blank cell. This prevents lines from joining tops and bottoms of error bars from different time points together.

The chart is created as follows:

First select cells A1:B7, press F11, and then choose the third radio button, X-Values for XY-Chart, in the New Chart dialog box. (This button tells Excel to regard A1:A7 as the X series in an XY chart.)

Open the Gallery menu, choose XY (Scatter), and select the second picture—the one that creates an XY chart with connected data points and markers. At this point you might also want to adjust the scale of the *y*-axis.

Now return to the worksheet, select cells C1:D18, and choose Edit | Copy. Go back to the chart, choose Edit | Paste Special, and fill out the dialog box as follows: Set the Values (Y) in Columns, and check the Series Names in First Row and Category (X Values) in First Column check boxes. Click OK and you have an XY chart with error bars, as the chart that is presented in Figure 2 shows.

Hershall Kaufman
Setauket, New York

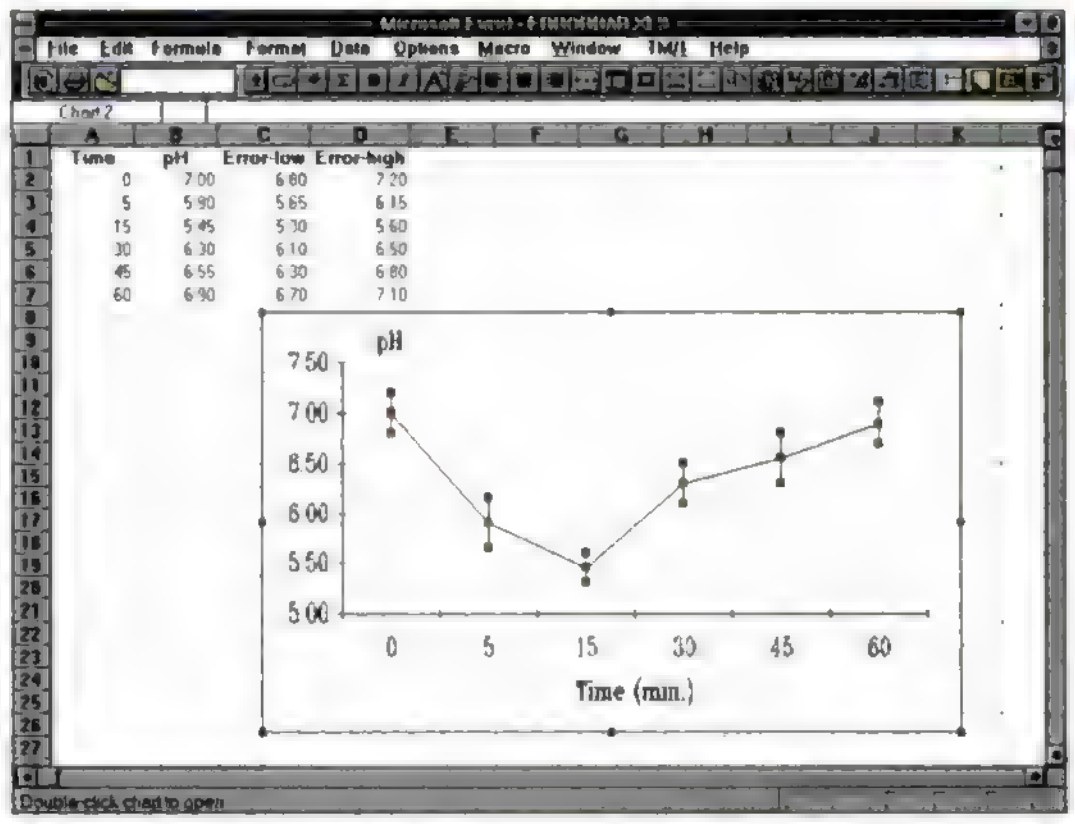

Figure 3: **The error bars in this Excel chart were produced with a somewhat easier method that uses hi-lo lines.**

▶PC MAGAZINE: The easiest way to understand Mr. Kaufman's workaround is to imagine that you are superimposing two XY charts that have a common set of *x*-values. The first chart plots time against pH; the second plots time against error data. The error-data chart includes redundant *x*-values, and each pair of identical *x*-values produces a vertical line (an error bar) in the *x,y* plot. The error-data plot also includes blank values, producing discontinuities between the error bars. The worksheet uses blanks in both column C and column D, but strictly speaking they're needed only in the Y series—in column D.

Fortunately, Excel 4.0 also offers a simpler workaround for plotting error bars. If you simply line up four columns of data—your *x*-axis values, your *y*-axis values, the high error values, and the low error values, you can simulate error bars by creating a line graph with hi-lo lines. For example, with the worksheet set up as shown in Figure 3, you create the graph in that figure as follows:

Select all four columns and press F11. In the New Chart dialog, pick the second option—Category (X) Axis Labels—and then choose OK. Pull down the Gallery menu, choose Line, then choose the seventh picture. Adjust the *y*-axis scale, if appropriate. Finally, select any point in the first data series (the values between the end points of the hi-lo lines), choose Format Patterns, and in the Line section of the dialog box, choose Automatic.

This second approach to error bars is easier to do and allows for a more natural arrangement of the underlying data. It has a couple of potential drawbacks, however. First, the high and low points on the error bars come from different data series and are, by default, drawn with contrasting markers. If you want them to look the same—for example, blue diamonds for both as in Figure 2, you'll need to do some additional formatting. Second, the values along the *x*-axis are considered to be category labels, not data points, so the first value does not coincide with the *y*-axis, as it does in Mr. Kaufman's XY graph.

If these deficiencies don't trouble you, you'll probably find the hi-lo method quicker and preferable. And maybe one of these days Microsoft will give Excel users (a great many of whom are engineers, according to Microsoft) genuine error bars.—*Craig Stinson*

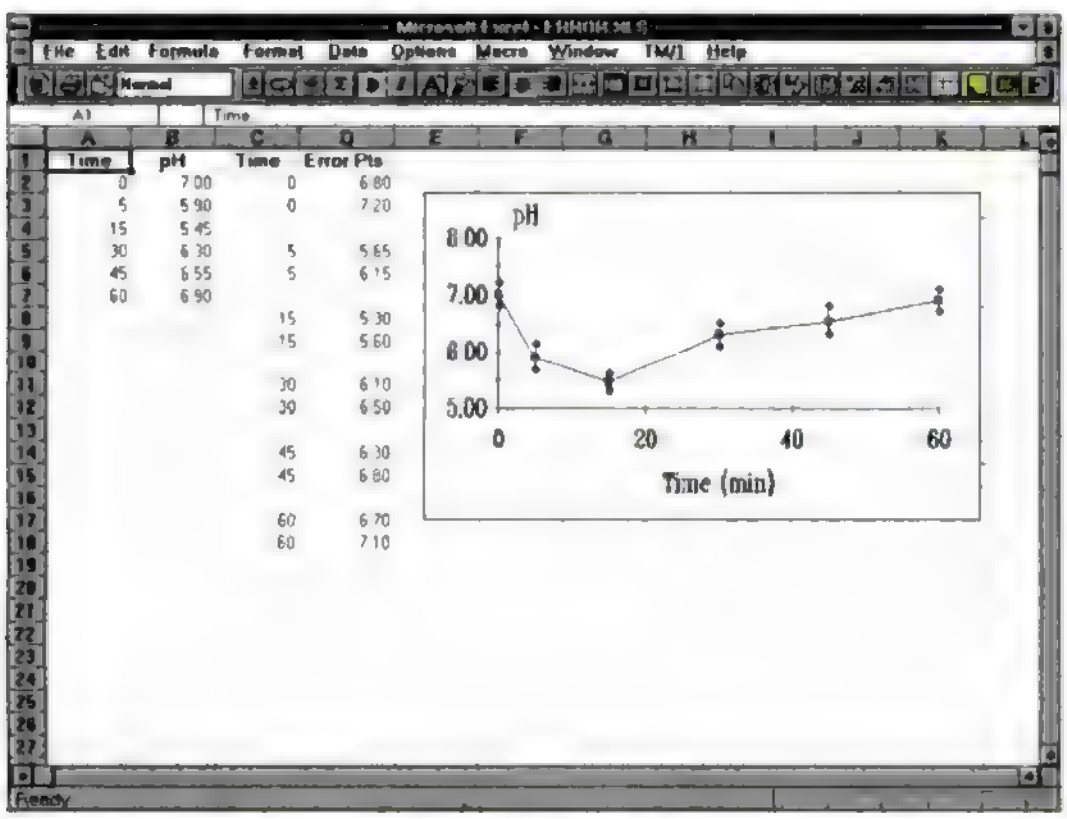

Figure 2: **This Excel chart plots the change in pH of dental plaque after a sugar rinse. The error bars were created using Edit | Paste Special.**

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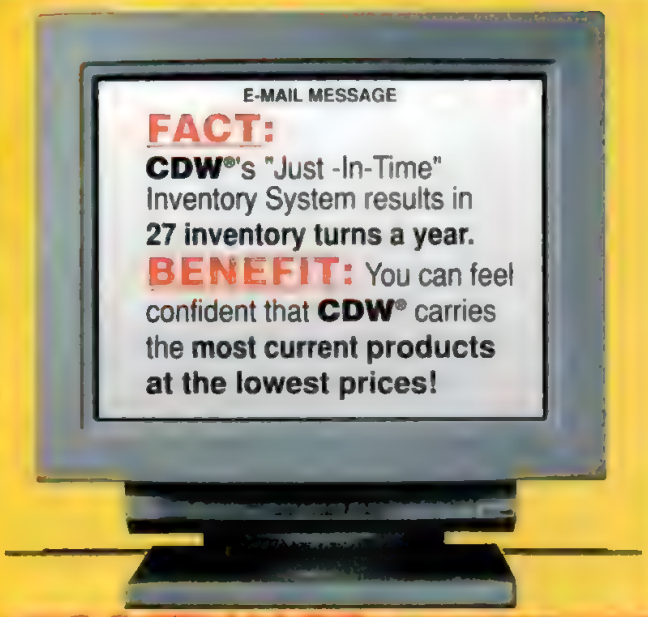

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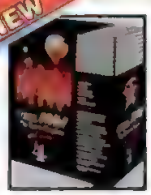

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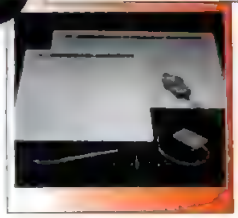

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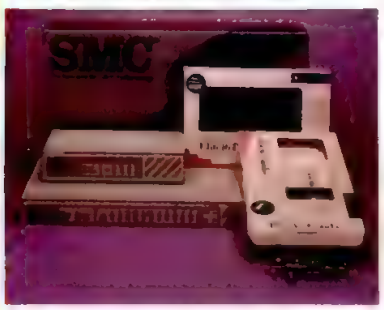

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Databases

HORIZONTAL SCROLLING IN CLIPPER

TIP The Clipper user-defined function shown in Figure 4 can be used to create an eye-catching message. The function scrolls text horizontally within a fixed region.

The Movechar() function is called with five parameters. The first parameter is the row where the message will be displayed. The second and third parameters are the leftmost and rightmost columns within which the text is displayed. The fourth parameter is the text itself. The fifth parameter can be used to adjust the speed of the moving characters, with a lower value producing faster moving characters.

The text continues to scroll until you press a key. If you would like to return the keycode for the key pressed, replace the line that reads

```
RETURN .T.
```

with

```
RETURN( mvkey )
```

This sends the result of the INKEY() function to the calling program.

Herry Hariry Amin
Jakarta, Indonesia

▶PC MAGAZINE: A routine to create this effect in FoxPro applications was presented in the January 14, 1992, issue.

Note that Movechar() calls the DELAY() function after each character is displayed. DELAY() is a processor-independent delay routine that first appeared in the November 26, 1991, Databases column. The delay routine accepts one parameter; the number of timer ticks by which to delay. A lower number means a shorter delay in this case and therefore, faster scrolling text.

To use DELAY(), you have to link in the DELAYC.OBJ file introduced in the November 26, 1991, issue. If you don't have that file, an easy alternative is to use Clipper's TONE() function, which can double as a timer-tick delay function.

The TONE() function is normally used to produce sound. You pass it two parameters: a frequency and a duration specified in timer ticks. Since frequencies below 20 Hz are inaudible, you can pass it a lower frequency and produce an inaudible sound for the desired interval to achieve a delay.

For example, if you don't have the DELAYC.OBJ file, replacing the

```
DELAY( mvspd )
```

line with

```
TONE( 0, mvspd )
```

will do the job just as well.

You can download the Movechar() function from PC MagNet. Look for MOVCHR.PRG in the Sol:Spreadsht DBMS section.—*Sal Ricciardi*

Graphics

FLATTENING AN EXPORTED CORELDRAW EPS IMAGE

I read your tip about avoiding PostScript problems when printing to a Linotronic from CorelDRAW ("Predicting PostScript Problems," January 26, 1993). You suggested increasing the Flatness setting in the Print dialog box to ensure that a complex file will print without a PostScript error.

This works fine if you're printing directly from CorelDRAW, but I print most of my work from Ventura Publisher. I export EPS files from CorelDRAW into Ventura. Just like regular PostScript files, EPS files can be too complex to print on a Linotronic. But CorelDRAW doesn't have a Flatness setting in the EPS export dialog box.

I've discovered, however, that a CorelDRAW EPS file does contain a default Flatness setting of 1.00. This setting, which actually reads "1.00 setflat," is inserted into every EPS file (or PostScript printer file) that CorelDRAW generates. Providing the EPS file doesn't contain a bitmap in the file header, the Flatness setting can be changed manually using any

MOVCHR.PRG
Complete Listing

```
*************************************************************************
* MOVCHR.PRG                                              Clipper 5.01
* Demo use of the Movechar function.
*************************************************************************
CLEAR
pcmag="PC Magazine PC Magazine PC Magazine PC Magazine PC Magazine "+;
      "PC Magazine PC Mag"
OldColor = SETCOLOR("W+/R")
@ 0, 0 TO 24, 79
FOR i = 1 to 23
     @ i, 1 SAY pcmag
NEXT
text = "*** Moving Characters Example, PC Magazine Databases ***
oclr = SETCOLOR("B/W")                    && Save and set color
@ 10,26 CLEAR TO 12,54
Movechar(11, 26, 54, text, 1 )            && Scroll the text
SETCOLOR(oclr)                            && Restore color
RETURN

*************************************************************
* Movechar - Display some "moving-characters" in a line.
* Clipper Summer '87, 5.00, 5.01.
*************************************************************
FUNCTION Movechar
PARAMETER mvrow, mvcl1, mvcl2, mvtxt, mvspd
PRIVATE mvlen, mvcnt, mvtxl, mvdln, mvkey
SET CURSOR OFF
mvlen = LEN(mvtxt)                        && Length of text
mvdln = (mvcl2 - mvcl1) + 1               && Length of display-space
mvcnt = 1                                 && Display-counter initializing
mvtxl = SPACE(mvdln)                      && Display-space initializing
mvkey = 0                                 && Loop flag
DO WHILE mvkey = 0                        && Display process
  mvtxl = SUBSTR(mvtxl, 2, mvdln - 1) + SUBSTR(mvtxt, mvcnt, 1)
  @ mvrow, mvcl1 SAY mvtxl
  mvcnt = mvcnt + 1
  IF mvcnt > mvlen
    mvcnt = 1
  ENDIF
  DELAY( mvspd )      && Databases, PC Magazine, Nov. 26, 1991
* TONE( 0, mvspd )
  mvkey = INKEY()
ENDDO
SET CURSOR ON
RETURN .T.
```

Figure 4: The Movechar() user-defined function scrolls a message horizontally within fixed coordinates.

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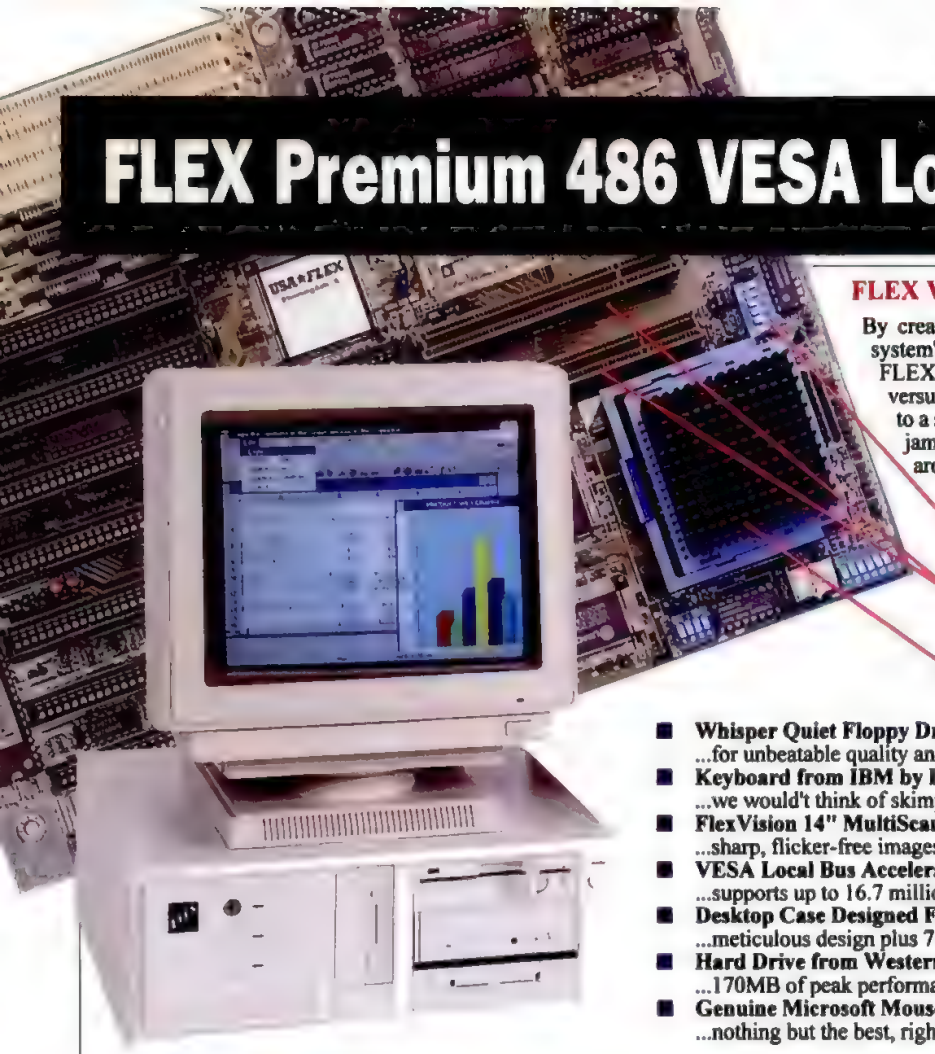

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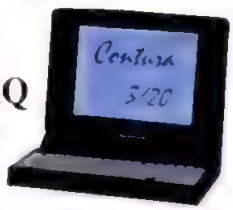

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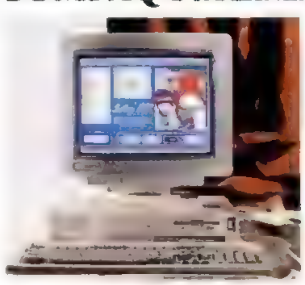

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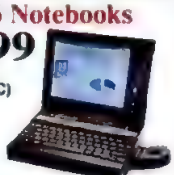

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T4400C	COLOR	i486DX	25	200	4MB/20MB	8K	82	NiCad	3			7.25	PC24-PA1150UT	$3899	DI-T324FM $199
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T4600	LCD	486SL	33	120	4MB/20MB	8K	82	NiCad	3+	MOUSE PORT, KB PORT, 1 SERIAL, 1 PARALLEL, SVGA	2 PCMCIA-2.0 (1 5MM, 1 16MM), 1 MEMORY 1 EXP. BUS	6.4	PA1201U-M2A	$2799	PCMCIA/CALL
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Code # PM07A3

CIRCLE 051 ON READER SERVICE CARD

text editor that can save files in ASCII format. (If there is a bitmap, it's important not to disturb the nontext characters.) I've safely used Windows Write to change the Flatness setting in EPS files. I just choose "No conversion" when I load the EPS file to ensure that the file remains in ASCII format.

The same procedure can be used on a CorelDRAW PostScript printer file if you forgot to increase the Flatness setting when you created the file. This is especially useful if you send your files out to a service bureau. In many cases the service bureau would rather make a one-byte fix than tie up a modem for an hour or so while you retransmit the file.

Jonathan Paterson
Montreal, Quebec, Canada

▶PC MAGAZINE: This is a great tip, but editing EPS (or Encapsulated PostScript) files directly is not for the timid. It requires that you understand a few basic concepts about the structure and nature of EPS files.

EPS files must conform to structuring conventions established by Adobe Systems (the developers of the PostScript specification). An EPS file must contain a header, a prolog, and a script. The header contains identifying information, such as the overall dimensions of an image. The prolog contains definitions or subroutines that can increase the efficiency of the PostScript code. The script contains the actual commands (also known as *operators*) that a PostScript-compatible output device interprets in order to print the picture.

The code can be stored in either binary or ASCII formats. CorelDRAW creates ASCII EPS files, and it is this plain-text format that makes it possible to edit the code using a word processing program. As Mr. Paterson notes, if you intend to use this technique you must be absolutely sure that your word processing program can read and write pure ASCII files. If your word processing program inserts control characters, the EPS file will be corrupted.

Although EPS files generally contain vector images, they can also contain bitmapped information. Usually (but not always) the bitmapped image is found in the header of the EPS file. A low-resolution bitmap of the picture is placed into the header for screen display purposes. This bitmap allows you to accurately position and size a representation of the actual picture when you import it into another application like Ventura Publisher. Without the bitmap, you'd see only a gray box that represents the overall dimensions of the EPS file. Despite the lack of aesthetic appeal, you must omit the bitmapped header image if you intend to edit your EPS files using a text editor, because handling bitmapped data in a word processor is a sure way to corrupt the file. When you export an EPS file from CorelDRAW, you are presented with a special dialog box that allows you to choose one of four Image Header options. Be sure to select None.

Once you've exported the EPS file, use an ASCII word processing program to bring the file up on-screen. Use your program's search function to locate the command `1.00 setflat`. Increasing the number will increase flatness, which in turn decreases the quality of the curves in your drawing. Increasing flatness in small amounts should not have a visible effect on the quality, but large increases will visibly degrade the quality of curves. Decreasing flatness will increase the complexity of the curves and make the drawing more difficult to print. Unless your service bureau has some suggestions, experimentation is the best way to discover the optimal Flatness setting. With possible acceptable settings anywhere between 0.01 and 100.000, Corel gives you both a wide range and fine control over flatness, but you'll want to use the lowest possible number that allows you to print a file successfully.

If you don't feel confident about choosing the best Flatness setting, you can use Corel's special Auto Increase function instead. Like the Flatness setting, the Auto Increase feature is found in the Print dialog box. When you turn Auto Increase on, CorelDRAW can automatically bump up the flatness setting when—and if—it encounters a printing problem. CorelDRAW will retry the print job until it increases the flatness by a factor of ten. So if you have left the default Flatness setting at 1.00, Auto Increase can use any Flatness setting between 1.00 and 10.00 to print your file. The advantage of Auto Increase is that it ensures the highest quality output because it uses the lowest possible Flatness setting on an object-by-object basis.

It should come as no surprise that CorelDRAW doesn't allow you to turn Auto Increase on when you export an EPS file. But you can use the same manual text-editing technique described by Mr. Paterson to invoke the Auto Increase function for an exported EPS file. First, export an EPS file of your drawing using the standard export options described earlier. In an ASCII-based text editor, look for the following line of code (near the beginning of the file):

```
/AutoFlatness false def
```

To turn Auto Increase on, simply delete the word *false* and insert the word *true*, so that the line reads

```
/AutoFlatness true def
```

AutoFlatness (that is, Auto Increase) works whether or not you're printing directly from CorelDRAW, because CorelDRAW includes the specialized code for the AutoFlatness routine in the prolog of every EPS file it creates.
—Luisa Simone

Networking

CONNECTING A CAMPUS-WIDE NETWORK

❓ Our resort has an administrative office at the foot of a hill and a front desk operation up the hill about half a mile. Each area has four PCs that all must access the same server. Both offices do a lot of printing and need speedy access to the software, which is really a DBMS. We have telephone lines between the locations, but we're not sure how to link them to put everyone on the same network.

Anne Davies
Boulder, Colorado

▶PC MAGAZINE: You have three alternatives for this kind of campuswide (resort-wide?) connection. A remote-access server is probably the most economical

solution. Under this type of system, PCs in one location use standard modems and dial lines to remotely control sessions on a multiuser PC located on the same high-speed cable as the file server. Novell's Access Server software combined with a fast 386 or 486 PC provides the least expensive choice of all. The new 1.3 version of the company's software has improved stability and throughput considerably.

Microdyne Corp. (800-255-3967 or 703-739-0500) markets a plug-and-play implementation of the NetWare Access Server (NAS) that includes four internal V.32bis modems, a LAN adapter, a 386 PC, and plenty of RAM. Microdyne had to modify the software to use the internal modems and it makes a neat package. The Microdyne NAS carries a suggested retail price of $8,995, but its street price is a good deal less.

One hint about using NAS: The type of video adapter in the access server influences the amount of memory available to applications in each session. Chances are that a DBMS application will take all the memory DOS can provide. If the hardware (Microdyne's NAS, for instance) has a VGA adapter, you can tell the software to treat it as a CGA and gain 100K or more of usable RAM under each remotely controlled session. Of course the quality of the image at the other end will go down, but throughput will go up and most DBMS applications don't use a lot of screen graphics.

If you want to make an investment in the future of your facility, consider installing a fiber-optic cable between the two operating locations. This cable, attached to a wiring hub or to a standalone fiber-optic transceiver at either end, will provide full-speed network operation. In the future, you can also use the fiber to carry traffic as diverse as closed-circuit video and environmental control information in addition to the network data. Installation, though, can run to tens of thousands of dollars. For a quote, you'll have to contact local contractors specializing in this type of activity.

If you can't install the fiber-optic cable and still want full Ethernet 10-megabit-per-second throughput, investigate Etherwave LAN Radio from Microwave Bypass Systems (617-843-8260). This radio system carries a price tag just under $30,000, but it makes a simple connection to the Ethernet cable and gives you 10-megabit-per-second connections over a distance of up to 15 miles.

NCR's WaveLAN—using UHF radio signals—can link network segments over a couple of miles, depending on the antennas you use. The product will give you a signaling rate of 2 megabits per second. You'd probably put a WaveLAN adapter in the file server in one facility and install another adapter with NCR's CoBridge software in a PC at the other location. You'll need two WaveLAN adapters (at a suggested price of $799 each) and one $995 copy of CoBridge. You'll also need two of NCR's special long-distance antennas for WaveLAN ($1,995 each). NCR says you can't just go down to Radio Shack and buy a cellular telephone antenna, which has the same connector, covers the same frequencies, and costs a tenth as much, because the devices weren't FCC certified in that configuration.—*Frank J. Derfler, Jr.*

FINDING ROOM IN THE SERVER

TIP I've read your advice about using multiple LAN adapters in the file server to segment the network traffic and improve throughput, but with a tape backup, CD-ROM, disk controller, and other devices in the server, we don't have enough slots or IRQs to add more adapters. Any hints on how to make more space?

Al Edmonds
Arlington, Virginia

▶PC MAGAZINE: First try using the Corel SCSI system to daisy-chain your SCSI devices such as CD-ROM drives and tape backup systems. Corel (800-836-SCSI or 613-728-8200) sells the package in both hardware and software configurations to match what you already have. If all your devices work together, you can attach as many as seven SCSI peripherals to one SCSI controller. Second, consider using a Kodiak-Quad Ethernet adapter from Kodiak Technology (800-888-8084 or 510-226-7840). This $799 adapter combines four Ethernet ports on one adapter with one IRQ. Each Ethernet processor has its own memory address, so you still must be very careful with your memory map, but avoiding the IRQ hassle and using only one card slot is a real plus in many installations.—*Frank J. Derfler, Jr.*

Languages

GETTING THE SHIFT STATUS IN PASCAL

? The October 15, 1991, Languages column, "Detecting Alt Keystrokes" contained a listing showing how to trap the shift-key status in BASIC. I have been unable to duplicate this in either Turbo Pascal or in assembly language using INT 21h. I need to trap the shift key to use in an editor in one of my applications. However, when I use the ReadKey function and then copy the byte at address $0000:0417 into a variable, the byte has already been reset to 0. The same is true if I try to AND that byte with 3, which should return the Shift-key status.

In assembler, I have tried to access this byte immediately after calling INT 21h function 1; again, the byte is always reset by then. I've tried MOVing it to a register, XORing it with a register, and PUSHing it onto the stack, but to no avail. I know it can be accessed, since I can see it in the Watches window of my Turbo Pascal IDE. How can I do this?

David D. Farris
Trinity, Texas

▶PC MAGAZINE: Your program's problem is right in the address $0000:0417. The dollar sign (indicating a hexadecimal number) is absent in the offset portion of this address, so it's treated as *decimal* 0417, equivalent to $01A1 in hexadecimal. The address $0000:$01A1 is right in the middle of the interrupt vector for INT 68h, which on many machines is always zero. The *correct* address for the shift state byte is $0000:$0417, or better still, $0040:$0017. Define a variable thus:

```
VAR ShiftState : Byte ABSOLUTE
 $0040:$0017;
```

and you have instant access to the shift states. The lowest 2 bits of the shift-state byte correspond to the right and left Shift keys, so the expression

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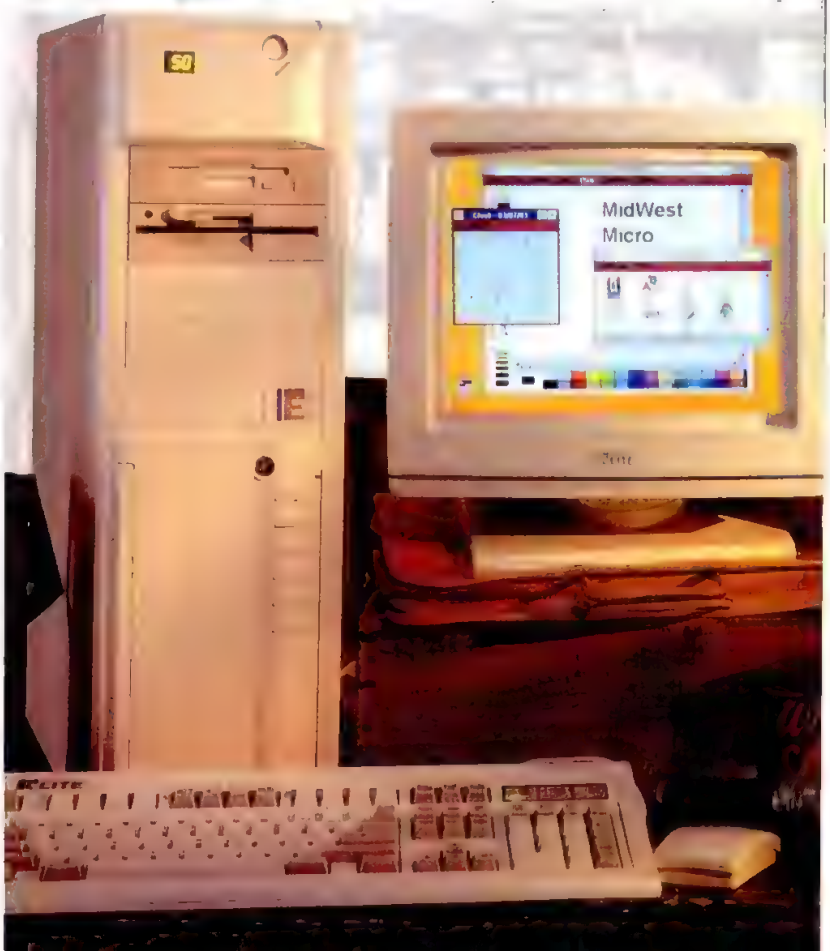

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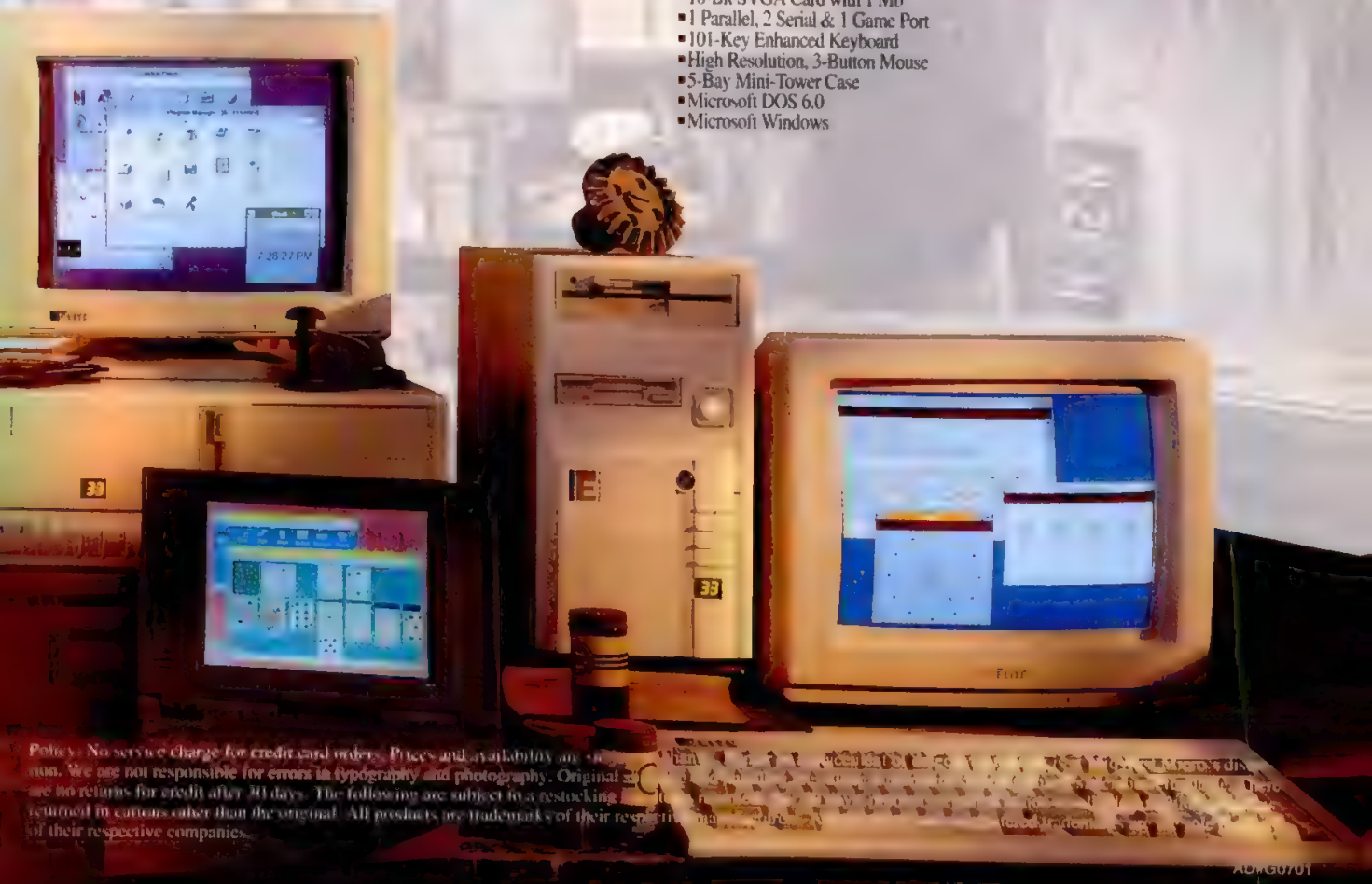

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- **83-key keyboard with 101-key emulation**
- **Built-in 2-button thumball mouse**
- **One parallel and one serial interface**
- **External VGA monitor and keyboard connectors**
- **FREE AC adapter, carrying case and MS-DOS**
- **One-year manufacturer's warranty**

Elite 486SLC-33 Monochrome

Model	Item #	Price
80 Mb	005446	$1299
120 Mb	005451	$1389
200 Mb	005456	$1499

Elite 486SLC-33 Color

Model	Item #	Price
80 Mb	005461	$1829
120 Mb	005466	$1929
200 Mb	005471	$2049

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Carrying Case
AC Adapter

MIDWEST MICRO

ELITE

486 Notebooks

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$1399

From MS-DOS 6.0, 3.5" 1.44 Mb floppy drive, AC Adapter, Utilities Support Disk

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A sub-notebook that weighs less than 4 lbs., stores unlimited amounts of data, powers through applications at 33 MHz and computes up to 50 percent longer. Sounds like a fantasy? With an Elite 486SLC-33 Subnote from MidWest Micro, it's your reality.

Small and Lightweight

MidWest Micro designed the Elite 486SLC-33 Subnote so you can take it anywhere – and everywhere. It weighs a mere 3.7 lbs. and measures 10" x 7" x 1.6".

Powerful Processor

Don't let the size fool you – the Elite Subnote is packed with power. It comes with a Cyrix 486SLC-33 MHz processor and 2 Mb of RAM. Need more power? Add an easy-to-install 2 Mb or 6 Mb upgrade for up to a total of 8 Mb.

Unlimited Data Storage

You'll never run out of storage space with an Elite Subnote. Once you fill its 80 Mb removable hard drive, simply take it out and insert another hard drive. There's no limit to the number of hard drives you can fill...or files you can save.

PCMCIA Slot

Take advantage of the latest in technology. With the Subnote's Type II interface, you can install PCMCIA cards for RAM, flash memory, modems and network adapters.

Advanced Power Management

The Elite's Advanced Power Management conserves battery life and allows you to program the setup utility to turn off or reduce power to components you are not using.

50% More Battery Life

Unlike other notebooks that use nickel cadmium batteries, the Elite Subnote features a nickel metal hydride battery that extends computing times by up to 50 percent.*

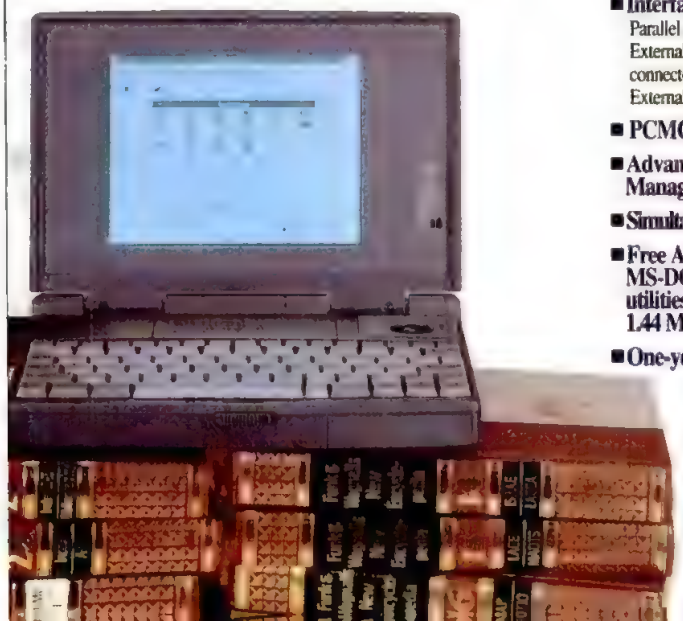
High-Resolution Display

With an Elite, you'll enjoy reading the fine print. The Subnote gives you 7.4" of display at 640 x 480 resolution – in 64 gray shades!

* Battery life measured with Power Management enabled. Actual battery life may vary

Features:

- **Processor:** Cyrix 486SLC
- **Processing speed:** 33 MHz
- **RAM:** 2 Mb of RAM, expands up to 8 Mb
- **Hard Drive** Removable 80 Mb hard drive
- **Screen:** 7.4" high-contrast screen 640 x 480 VGA resolution 64 gray shades
- **Video RAM:** 256K
- **Weight:** 3.7 lbs. with battery
- **Size:** 10" x 7" x 1.6"
- **Battery:** Nickle metal hydride battery Up to eight hours with APM
- **Keyboard:** 79-key with 101-key emulation Built-in 2-button trackball Drag button
- **Interfaces and ports:** Parallel and serial interfaces External keyboard and modem connectors External floppy port
- **PCMCIA Type II slot**
- **Advanced Power Management**
- **Simultaneous video**
- **Free AC adapter, MS-DOS 6.0 installed, utilities support disk and 3.5" 1.44 Mb floppy drive**
- **One-year warranty**



Notebook Add-Ons

Model		Item #	Price
Internal 9600 V.42bis fax modem		003649	$159
Car adapter cable		004007	$15
AC mobile adapter		004003	$89
External battery charger		004004	$89
Battery, nickel cadmium		004002	$55
Battery, nickel hydride		004056	$68
Docking station		004018	$429
RAM upgrades	2 Mb (SLC)	004052	$104
	4 Mb (SLC)	004053	$191
	6 Mb (SLC)	004054	$279

Subnote Add-Ons

Model	Item #	Price
2 Mb RAM upgrade	003662	$109
6 Mb RAM upgrade	003663	$319
80 Mb removable hard drive kit	003708	Call
120 Mb removable hard drive kit	003669	Call
9600 send and receive fax with 2400 modem	003661	$149
Quick charge adapter	003664	$89
Car adapter	003666	$45
Nickel hydride battery	003665	$119

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AD#G0703

CIRCLE 398 ON READER SERVICE CARD

SHIFTKEY.PAS

Complete Listing

```
PROGRAM ShiftKey;
USES Crt;
VAR
  ShiftState : Byte ABSOLUTE $40:$17;
  OldState   : Byte;
  C          : Char;

  PROCEDURE ShiftReport;
  VAR ro, co, N : Byte;
  BEGIN
    ro := WhereY; co := WhereX;
    Window(1,1,80,25);
    OldState := ShiftState;
    FOR N := 0 TO 7 DO
      BEGIN
        GotoXY(5+N*7, 25);
        IF ShiftState AND (Word(1) SHL N) <> 0 THEN Write('X')
        ELSE Write(' ');
      END;
    Window(1,1,80,24);
    GotoXY(co,ro);
  END;

BEGIN
  C := #0;
  OldState := ShiftState;
  ClrScr;
  GotoXY(1,25);
  Write('Rsh[ ] Lsh[ ] Ctl[ ] Alt[ ] Scr[ ] Num[ ] Cap[ ] Ins[ ]');
  Window(1,1,80,24); GotoXY(1,1);
  WriteLn('Press shift and regular keys.  <Esc> to quit.');
  REPEAT
    REPEAT UNTIL KeyPressed OR (OldState <> ShiftState);
    IF KeyPressed THEN
      BEGIN
        C := ReadKey;
        IF C = #0 THEN Write('(', Ord(ReadKey), ') ')
        ELSE Write(C);
        IF C=^M THEN Write(^J);
      END;
    IF OldState <> ShiftState THEN ShiftReport;
  UNTIL C = #27;
END.
```

Figure 5: **This Turbo Pascal program demonstrates a way to poll changes in the shift-key-state byte while accepting normal keyboard input.**

```
ShiftState AND 3 <> 0
```

will be true any time one of those keys is pressed.

Figure 5 is a simple Turbo Pascal program that polls changes to the shift state along with regular keystrokes. Special keys like arrow and function keys are displayed as their extended ASCII values, in parentheses. Any time the shift state changes, the program calls the procedure ShiftReport to update the check boxes located next to the eight shift names on the bottom line of the screen and to record the new shift state in the variable OldState.

You can download SHIFTKEY from PC MagNet's Programming Forum, archived as SHIFTK.ZIP.

—Neil J. Rubenking

Communications

CALL WAITING AND MODEMS

❓ I'd like to hook up a modem to my computer, but I heard that I need a second phone line since call waiting could knock the modem off-line and screw up my computer. I'd rather not get a second line. Is there anything else I can do?

Eugene Y. Ke
Grand Prairie, Texas

▶**PC MAGAZINE:** It's true that with call waiting the click or tone in the phone line that indicates a second incoming call makes your modem think it lost the carrier and hang up. But this won't damage either your modem or computer; the worst that can happen is that, if you're transferring a file when the carrier drops, you'll lose part of the file. Most telephone companies that offer call waiting also provide a way to disable it temporarily so that the tone won't interrupt modem or fax communications. The only reason to get a second phone line is if your phone company doesn't offer this.

The secret is to add a special code sequence to your communication program's dialing string. You have to use the code each time you dial out, because it only disables call waiting for the current call. For Touch-tone phones, the code string is *70 (where * is the star symbol on the phone keypad); for rotary or mechanical dial phones, the string is "1170."You should also add the modem command for a pause after the code, to make sure the phone system has time to react before your computer sends out the actual phone number. For modems that follow the Hayes-type AT command set, the command that tells the modem to pause for a half-second is a , (comma). So if you have a Touch-tone phone, your dialing string will be

```
ATDT*70,555-1234
```

For a rotary phone, the string would be

```
ATDP1170,555-1234
```

There are several ways to add the code to your dialing strings, depending on the communications program you're using. The simplest is to edit all telephone numbers in the dialing directory, adding the appropriate code in front. Most communications programs also support automatically adding a dialing prefix (for international calls or for PBX systems that require a 9 to get an outside line). If yours does, just enter the appropriate code as the prefix according to the program's documentation. Then the code will be sent automatically each time you dial out.

The easiest way to find out if your telephone company supports these codes is to check your phone book. The section of the book that covers call waiting should include the information on the appropriate codes to disable it. If the information isn't there, call your phone company's business office.—*Joe Salemi* □

How PC Direct Helped Computer Discount Warehouse Found "Customer University"

All the employees at the Computer Discount Warehouse are still in school. No, they're not teenagers anymore, but they're all enrolled in a program called CDW University—which they also call "Customer U."

"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell—and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a $10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it—closing rate, calls per ad dollar—PC Magazine is tops."

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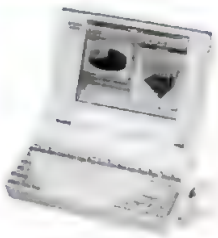

TOSHIBA

T1850

- 4MB RAM, expandable to 12MB
- Max Time Power system

Processor	DOS	DOS,Windows, Trackball
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Lease for $53.54/mo.

$1459

COMPAQ

Contura 3/25

- 25 MHz 386SL
- 4MB expandable to 12MB
- 64KB cache
- MS-DOS, Windows, Trackball

Display	Hard drive	Price
Color	120MB	$1599

Lease for $58.68/mo.

$1599

TEXAS INSTRUMENTS

TravelMate 4000

- 486 processor
- 10" display, 64 gray scale
- MS-DOS, Windows 3.1

Processor	RAM	Hard Drive	Price
486SLC/25	2MB	60MB	$1639
486SLC/25	4MB	80MB	$1719
386SX/25	4MB	120MB	$1899
486DX/25	4MB	120MB	$2099
486DX/25	4MB	200MB	$2599
486DX2/50	8MB	200MB	$2999

Lease for $60.15/mo.

$1639

AST

PowerExec

- 4MB RAM, expandable to 20MB
- Trackball, 2 PCMCIA slots
- Windows 3.1

Screen	Model	Price
386SL25Mono	83/W	$2009
386SL25Mono	123/W	$2049
386SL25Active Color	203/W	$3499
486SL25Mono	203/W	$2429
486SL25Active Color	203/W	$4029

Lease for $73.73/mo.

$2009

NEC

UltraLite Versa

- 25MHz 486SL processor
- 4MB RAM, expandable to 20MB
- 2 PCMCIA slots
- Local bus graphics
- MS-DOS, Windows 3.1, trackball

Screen	Hard drive	Price
Mono	120MB	$2749
Mono	180MB	$2999
Active Color	120MB	$3839
Active Color	180MB	$4049

Lease for $100.88/mo.

$2749

COMPAQ

LTE Lite/25

- 25MHz 386SL
- 4MB RAM, expandable to 20MB
- MS-DOS, Windows 3.1
- Built-in trackball

Screen	Hard drive	Price
Active matrix mono	120MB	$3029
Active matrix color	85MB	$2999
Active matrix color	120MB	$3459

Lease for $110.06/mo.

$2999

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Texas Instruments TravelMate 4000.

More power, more choices, more value. TI's new 486 TravelMate notebook computers offer outstanding price/performance. With a choice of 486 processors, monochrome or color displays, it's easy to find just the right TravelMate for your application needs. TI's 50MHz notebook weighs only 5.6 pounds, making it the fastest, and lightest notebook on the market today. To achieve speeds of 50MHz, road test the TravelMate 4000 WINDX2/50.

TEXAS INSTRUMENTS

TravelMate 4000 WinSX25 Color

- 4MB expandable to 20MB
- 120MB hard disk drive
- 640 x 480 VGA display (9.4")
- 256 colors
- Microsoft BallPoint with QuickPort connection
- MS-DOS 5.0, Windows 3.1

Lease for $95.38

$2599

TEXAS INSTRUMENTS

TravelMate 4000 WinDX2/50

- 8MB RAM expandable to 20MB
- 200MB hard disk drive
- 640 x 480 VGA display (10")
- 64 gray scales
- Microsoft BallPoint with QuickPort connection
- MS-DOS 5.0, Windows 3.1

Lease for $110.06

$2999

TEXAS INSTRUMENTS

TravelMate 4000 WinDX2/40 Color

- 8MB expandable to 20MB
- 200MB hard disk drive
- 640 x 480 VGA color display (9.4")
- 256 colors
- Microsoft BallPoint with QuickPort connection
- MS-DOS 5.0, Windows 3.1

Lease for $133.91

$3649

Long Battery Life and 486 Power!

TI's revolutionary BatteryPro software prolongs the battery life while providing a complete power management and monitoring system. BatteryPro is compatible with Microsoft's Advanced Power Management (APM). In addition, BatteryPro lets you see the battery life remaining at a glance. Together, APM and BatteryPro give you a complete power management solution, giving you ample time to take advantage of the state-of-the-art 486 processing.

Working in Windows Has Never Been Faster!

Accelerate into your applications using the TravelMate's Drop N' Go software utility, saving time and battery life. Drop N' Go allows you to take advantage of the new drag and drop feature within Windows 3.1 File Manager.

Make the Right Connections

A full range of options are available for TravelMate 4000 Series, making it easy to stay in touch while on the road.

14.4/96 S/R FAX/Modem	$559.99
Ethernet Adapter	$449.99
SCSI Adapter	$359.99
Token Ring Adapter	$589.99
External Battery Charger/Discharger	$129.99
Deluxe Carrycase	$56.99
Expansion Station	$819.99
Extra Battery Pack	$84.99
4MB Memory	$249.99
16MB Memory	$1799.99

PC MAGAZINE EDITORS' CHOICE

March 30, 1993
TravelMate 4000 WinDX2/50

TEXAS INSTRUMENTS

CIRCLE 092 ON READER SERVICE CARD

Toshiba Direct.

Toshiba has been an industry innovator since its introduction of the first commercially accepted DOS-based portable in 1985. Always responsive to user demands for more power, lighter weight, and increased capabilities, Toshiba has introduced a broad range of technological innovations to the marketplace, including active matrix color technology. Toshiba active matrix color notebooks deliver up to 256 simultaneous colors at 640x480 resolution from a palette of up to 185,193 colors. Explore a full range of powerful, lightweight Toshiba notebooks and accessories implementing breakthrough technology, now available from your super direct source.

TOSHIBA

T4500

- 4MB RAM, expandable to 20MB
- PCMCIA slot
- 6.4 lbs.
- MS-DOS, Windows, Trackball

Processor	Hard drive	Price
i486SX20	120MB	$2069
i486SX20 Color	120MB	$3299

Lease for $82.53/mo.

$2069

TOSHIBA

T4400C COLOR

- 25MHz i486SX
- 4MB RAM, expandable to 20MB
- 120MB hard drive
- 9.5" active matrix color display

$3999

- 25MHz 486DX
- 200MB configuration

$3969

Lease for $124.74/mo.

$3999

TOSHIBA

T6400

- 4 MB, expandable to 36MB
- Full 101-key keyboard
- One full-length expansion slot

Processor	Hard Drive	Price
i486DX2/50 plasma	200MB	$3699
i486DX2/50 color	200MB	$5739

Lease for $135.75/mo.

$3699

Toshiba MaxTime Power Management

MaxTime Power Management coordinates all hardware and software system elements to extend battery life. MaxTime allows Toshiba notebooks to operate in normal full power mode or in either of two standard power saving modes, or in a custom user-defined mode. In the power saving modes, select processing speed, display brightness and auto-off settings, and hard drive power down when not in use.

ExceptionalCare

All Toshiba notebooks are backed by ExceptionalCare warranty service. Get 48 hour turnaround for repairs or replacement. ExceptionalCare is available anywhere in the United States and in more than 20 international locations.

Desk Station IV

Turns the T3300,T4500,T4400 into a full function desktop

- 2 full size 16-bit expansion slots
- 1 5.25" half height drive bay
- Parallel, serial, PS/2 mouse, VGA monitor, 101-key keyboard ports
- 1 floppy disk drive port

Carry Case

- Full line of lightweight, durable carry cases
- Available in fabric or leather
- Contoured padded shoulder straps
- Pockets for diskettes, AC/auto adapters, extra batteries, and cables

AST, COMPAQ, and NEC Now Available!

LEADING EDGE

WinPro 486 E

- 4MB expandable to 32MB
- 8KB cache expandable to 256KB
- Windows Accelerator
- MS-DOS, Windows 3.1, MS-Works MS-Productivity, Quicken for Windows

Processor	Drive	Price
486SX/25	120MB	$979
486SX/33	170MB	$1099
486DX/33	170MB	$1259
486DX/33	260MB	$1369
486DX2/66	260MB	$1599

Lease for $50/mo.

$979

NEC

Ready Desktops

- 4 MB RAM
- 3.5" and 5.25" floppy drives
- 9600/4800 fax, 2400 data modem
- MS-DOS, Windows 3.1 PFS:WindowWorks, Prodigy, Quicken
- Mouse

Processor	Hard Drive	Price
386SX25	170MB	$1199
486DX33	170MB	$1499

NEC SVGA color monitor $349.99

Lease for $50/mo.

$1199

AST

Bravo Desktops

- 4MB RAM expandable to 64MB
- 120MB hard drive
- MS-DOS, Windows 3.1, MS Mouse

Processor	Model 213/W
4/25s	$1449
4/33	$1799
4/50d	$2199
4/66d	$2269

Bundles include AST SVGA color monitor

Lease for $50/mo.

$1449

COMPAQ

DESKPRO/i 4/25is

- 25 MHz 486SX
- 4MB RAM
- 120MB hard drive
- 3.5" floppy drive
- QVision graphics controller
- Business audio
- MS-DOS, Windows 3.1, mouse

$1499

240MB configuration

$1689

Compaq SVGA color monitor $349.99

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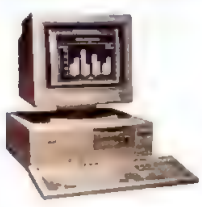
$1499



COMPAQ

DESKPRO/M

- 4 32bit EISA expansion slots
- Intelligent modularity
- QVision graphics controller
- MS-DOS, windows 3.1, mouse

Processor	Hard Drive	RAM	Price
486SX/25	120MB	4MB	$2129
486DX/33	120MB	4MB	$2469
486DX2/66	510MB	8MB	$3739

Compaq SVGA color monitor $349.99

Lease for 78.13/mo.

$2129

AST

Premmia Desktops

- 8MB RAM expandable to 128MB
- 5 EISA slots, 5 drive bays
- 1.44MB 3.5" floppy drive
- Local bus, 1280x1024 resolution
- MS-DOS, Windows 3.1, MS mouse

Processor	Drive	Price
4/33	170MB	$2879
4/66d	340MB	$3329

AST SVGA color monitor $399.99

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2 Serial & 1 Parallel Port
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Fully Upgradable Intel 80486 CPU
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32 Bit VL-Bus IDE Controller
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1.2 MB 5.25" Floppy Drive
1.44 MB 3.5" Floppy Drive
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Save money while helping save our planet.

Ask about our new full line of new energy-saving "green PC's". Four Intel 486-based Insight EcoSystem™ computers, meeting the requirements of the U.S. Environmental Protection Agency's Energy Star Computer Program will be available in June.

The Energy Star Program's goal is to promote the manufacturing of computers, monitors and printers that can switch to a low-power consumption state when not in use. To qualify as an Energy Star computer system, each component must use 30 watts or less when in the low-power state. Typical systems use as much as several *hundred* watts.

The Insight EcoSystem™ line features four speeds -- 486SX-25, 486SX-33, 486 DX-33 and 486DX2-66MHz -- ranging in price from $2,199 to $2,694. The configurations include a low-profile case, 4MB RAM, a 250MB HDD, 1.44MB floppy drive, local bus video, keyboard, DOS 6.0, Windows 3.1 and a 15" monitor. The mother-board uses less power than comparable systems, and the hard drive and monitor support power-down. At idle the power consumption for the complete system is no more than 60 watts. Call today for more information.

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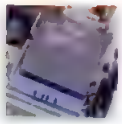

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Awesome 486 performance now, break-neck performance tomorrow! All Insight 486's are OverDrive™ upgradable and contain a socket for easy processor swaps. Choose an Insight VESA® VL-Bus™ compatible system and you'll be upgradable all the way to the next generation.

Vroom!

Fast Insight Computers. We're talking a rocket ship on your desk! From video to hard drive, Insight Computers give you the performance you've been dreaming of. But don't just take our word for it: "Speedy Insight 486 loaded with multimedia options." **Buyers Assurance Award** -*InfoWorld 2/15/93*
"If you are looking for a system with one of the fastest hard disk subsystems around, look at the Insight 486-50 Windows Ultra." -*Windows Sources, 3/93*
"...an excellent Graphics WinMark rating that placed the unit among the top ten systems reviewed."
-*PC Magazine 2/23/93*
"The system's outstanding performance reflects its bus design." -*PC Computing 3/93*

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Colors So Bright You'll Need Sunglasses.

With Insight's standard 24-bit Super VGA Windows Accelerator Video Card you'll see more than 16 million colors that scream through Windows applications as bright and sharp as the eye can see. For VESA® video, watch out! Insight has discovered one of the fastest 32-bit VESA® video cards available and made it standard on all VL-Bus™ systems.

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Our desktop and full vertical cases are solidly crafted with heavy-gauge metal and provide you with maximum expandability to accommodate your every growth need. Our full vertical case option includes dual cooling fans, a 250 watt power supply (UL, CSA, TUV listed), 5 open expansion bays to add tape backup, CD-ROM and drives internally!

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Need to add another hard drive in the future? No problem. No hassles! Our hard drive controller and dual cable (included at no extra charge) allow you to simply plug in another hard drive.

Insight VL-BUS™
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I43VLM425F
486DX-33MHz.... $1,899
486DX-50MHz.... $1,999

Fully Upgradable Intel 80486 CPU
VESA VL-Bus™ Compatible Slots
4MB RAM - 128K Cache
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32 Bit VL-BusTM Compatible IDE Controller
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1.44MB 3.5" Floppy Drive
2 Serial, 1 Parallel
Enhanced 101 Key Keyboard
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Desktop Case, Full Vertical available

"When you consider the components, the benchmark scores and the service and support, the Insight is a winner."

Winner of *Windows Sources* Expert's Pick. *Windows Sources*, May 1993

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85MB	17ms	3.5" 1"H	Quantum	SCSI	QUELS85S	219	369
85MB	15ms	3.5" 1"H	Western Digital	IDE	WD28ØA	199	219
106MB	15ms	3.5" 1"H	Seagate	IDE	ST312ØA	189	209
120MB	16ms	3.5" 1"H	Talon	IDE	TA3Ø2ØA	199	219
127MB	17ms	3.5" 1"H	Quantum	SCSI	QUELS127S	259	409
130MB	15ms	3.5" 1"H	Seagate	IDE	ST3144A	199	219
170MB	12ms	3.5" 1"H	Western Digital	IDE	WD217ØA	249	269
170MB	17ms	3.5" 1"H	Conner	IDE	CP3Ø174A	249	269
210MB	14ms	3.5" 1"H	Seagate	IDE	ST3243A	279	299
210MB	15ms	3.5" 1"H	Maxtor	IDE/SCSI	MX7213A/S	289	309/439
240MB	9ms	3.5" 1"H	Maxtor	IDE/SCSI	QULPS24ØA/S	359/369	379/519
245MB	12ms	3.5" 1"H	Conner	IDE	ST3283A	279	299
250MB	12ms	3.5" 1"H	Western Digital	SCSI	WD225ØA	299	449
250MB	11ms	3.5" 1"H	Talon	IDE	TA3122A	289	309
250MB	15ms	3.5" 1"H	Maxtor	IDE	MX7245A	299	319
340MB	12ms	3.5" 1"H	Western Digital	IDE	WD234ØA	409	429
340MB	15ms	3.5" 1"H	Maxtor	IDE	MX7345A	399	419
420MB	12ms	3.5" 1"H	Western Digital	IDE	WD2420A	569	589
452MB	12ms	3.5" 1"H	Seagate	IDE/SCSI	ST355ØA/N	529/609	549/759
510MB	12ms	3.5" HH	Fujitsu	IDE	FJ2624A	739	759
520MB	12ms	3.5" HH	Fujitsu	SCSI	FJ2624S	739	889
525MB	11ms	3.5" 1"H	Seagate	SCSI	ST36ØØN	759	909
540MB	9ms	3.5" 1"H	Maxtor	IDE/SCSI	MX54ØAL/SL	999	1,019/1,149
545MB	10ms	3.5" 1"H	Conner	IDE/SCSI	CP3Ø544/Ø	999	1,019/1,149
660MB	16ms	5.25" FH	Seagate	SCSI	ST4766N	979	1,139
1000MB	12ms	3.5" HH	Fujitsu	SCSI	FJ2694S	1,199	1,319
1000MB	15ms	5.25" FH	Seagate	SCSI	ST412ØØN	999	1,149
1050MB	11ms	3.5" FH	Seagate	SCSI	ST112ØØN	1,129	1,279
1420MB	15ms	5.25" FH	Seagate	SCSI	ST4165ØN	1,349	1,499
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-PC Magazine

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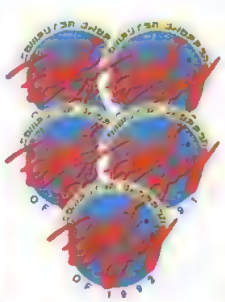

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June 27 1989
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Win for Workgroups MLP	129
Win for Workgroups Starter Kit	389
Win for Workgroups User Kit	289

Artisoft

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AE-2 Ethernet Starter Kit Windows	599
AE-3™ Ethernet Starter Kit DOS	549
AE-3 Ethernet Starter Kit Windows	599
LANtastic/AI (single node)	69
LANtastic/AI (up to 300 users)	1,599
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LANtastic for NetWare Network Operating System	329
ArtiCom Modem Sharing software	259
A2Mbps Starter Kit DOS	359
A2Mbps Starter Kit Windows	429
Extra AE-2 Boards	199
Extra AE-3 Boards	239
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Colorado 250MB	219
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Exabyte

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Mac Transportable 150	799
PC2B Interface Card	159

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88EI, 88MB ext. drive, 8 Bit adapter, 1 cart	579

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Discovery CD 8 Internal Kit	$449
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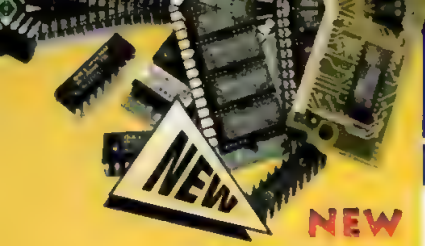

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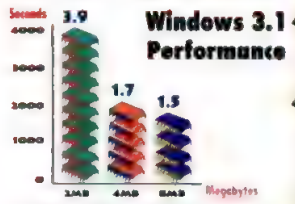

Windows 3.1 Performance

*This graph displays the amount of time it takes to run one specific Windows application with the indicated amount of memory.

- An upgrade from 2MB to 8MB can increase performance up to 160%
- Memory allows Windows to run faster
- Reduces your system's need to access the hard disk
- Speeds up programs which use virtual memory
- Allows you to utilize numerous and extensive applications at the same time

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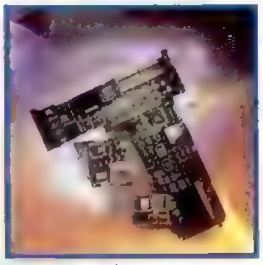

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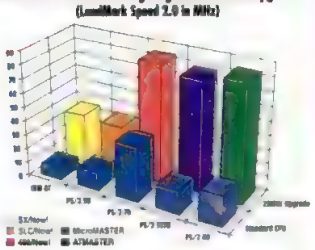

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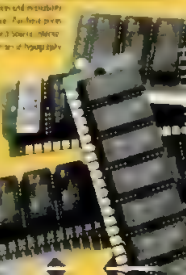

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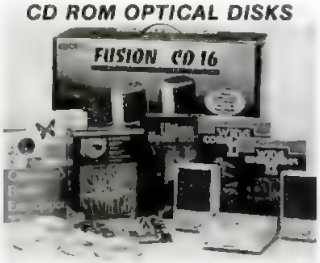

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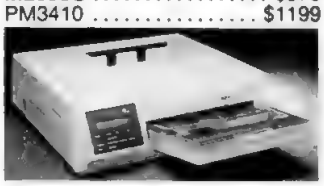

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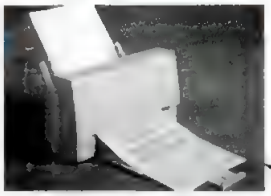

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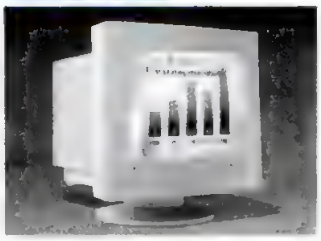

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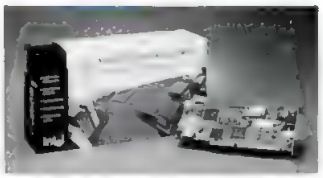

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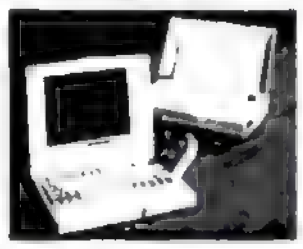

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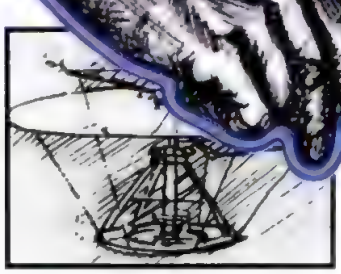

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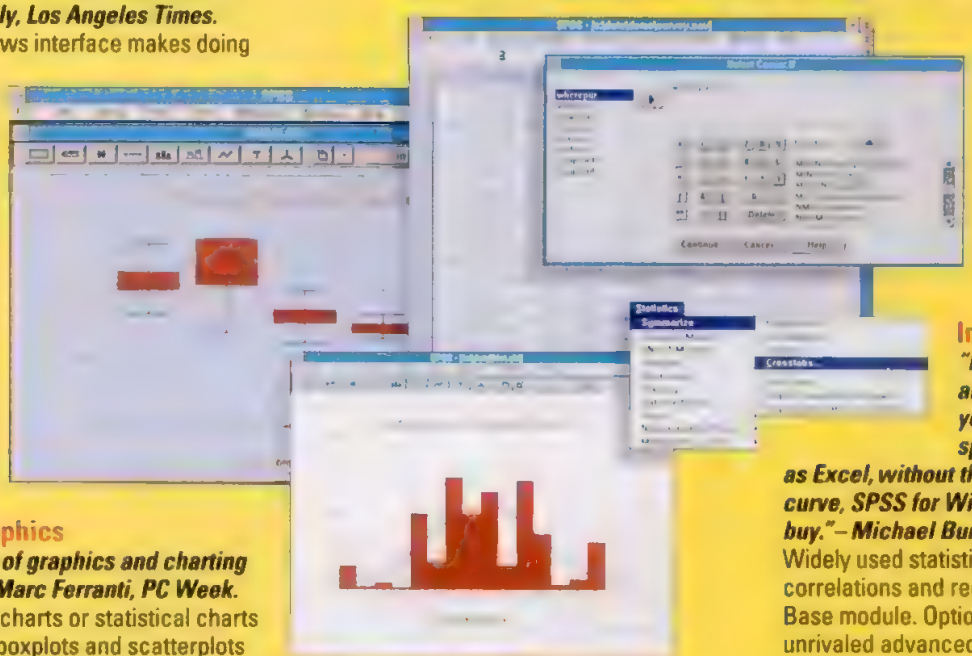

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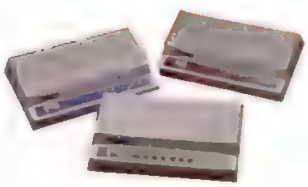

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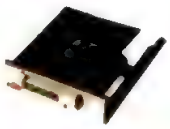

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Winners will be announced at the Software Development '93 Summer Conference in Boston the week of August 23, and announced on ZiffNet as part of their ongoing coverage of SD '93 Summer. Entries must be post-marked by August 5, 1993. Please see the rules below for complete details.

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OFFICIAL CONTEST RULES

1. To qualify, a program must be a standalone utility that boosts a programmer's productivity. It must run under MS-DOS, version 5.0 or later, Windows, version 3.1; OS/2, version 2.x; or Windows-NT. The utility can be written in any mainstream computer language — such as assembly, C, C++, Pascal BASIC (including Visual Basic), or Smalltalk — as long as the program is a standalone executable

   Each entry must include all files necessary to build the application, a project, Make, or batch file with which to compile the program, and the executable program. In addition include an ASCII text file (README.TXT) with: your name, address, daytime phone number, and e-mail address (if any) the language the utility is written in, the compiler used, a five or six sentence description of what the program does; and a five to ten sentence description of how the program works

   Entries may be submitted electronically via the ZiffNet service (hosted by CompuServe) or by mail (on 5 1/4- or 3 1/2-inch high density floppy disks). To submit electronically, ZIP all files together (1.x or 2.x format) and upload to ZiffNet/CIS account number 72241,104. To submit by mail Label the floppy disk with your name, address, and daytime phone number, and send to Programmer's Utility Contest, PC Magazine, One Park Avenue, New York, NY 10016. All entries must be time stamped or postmarked no later than midnight, August 5, 1993 and received by August 10, 1993. We cannot be responsible for lost, late, or misdirected mail
2. Entries will be judged on the basis of originality, usefulness, ease-of-use, performance, interface design, environment integration, and code size among other criteria. One first prize will be awarded for Best Utility. The winner will receive a small, stocked refrigerator (approximate retail value, $300), a cash prize of $500, and have his utility published in part in PC Magazine and distributed on the PC Magazine Programmer's Forum on ZiffNet. The winner will be required to submit, within 30 days of notification, documentation describing how to use the program and how it works. In the event of noncompliance, an alternate winner will be selected

   Second prizes will include Best DOS utility, best Windows utility, best OS/2 utility, and best Windows-NT utility. Each second prize winner will receive a PC Magazine jacket (approximate retail value: $30 each), will be listed in PC Magazine as a second prize winner, and will have their program distributed in the Programmer's Forum. To be distributed on-line, winners will be required to supply documentation for using the program. All judging will be under the supervision of Ziff-Davis Publishing Company, whose decisions are final on all matters relating to this offer. Ziff-Davis is not responsible or liable for any warranty or guarantee either express or implied on any prize awarded. All winners will be notified by phone on or before August 19, 1993. Prizes will be awarded at the Software Development Conference on August 24, 1993. If a winner is unable to attend the conference, the prize will be mailed
3. This contest is open to all U.S. citizens except employees of Ziff Communications Company and its subsidiaries, affiliates, and advertising and commercial agencies, and the families of such employees. All federal, state, and local laws and regulations apply. The contest is void where prohibited by law. All federal, state, and local taxes on the prize are the sole responsibility of the winner. The media on which entries are submitted become the sole property of Ziff Communications Company and none will be returned. By entering the contest each entrant represents, warrants, and agrees that: his/her entry is original, it has been written on his/her own time, it has not been previously published or distributed, it does not infringe or violate the rights of any third party, it has not won previous prizes or awards, it does not contain faults, defects, viruses, worms or built-in time or use-driven destruct mechanisms or injurious or damaging formulas, instructions or other materials and, if the entry is selected as a first or as second prize winner, he/she will grant to Ziff Communications Company, its affiliates and designees the non-exclusive worldwide perpetual right to (a) reproduce, publish, distribute and display his/her entry and the associated documentation, as submitted, as it may be edited and/or as it may be adapted into an article by PC Magazine, in whole or in part, in all languages, forms and media and for any purpose, including without limitation on on-line services and as premiums, and b) authorize third parties to use the entry and all associated files in the ordinary and customary way (such as downloading, loading, storing, displaying, copying, and distributing via network and otherwise). Ziff Communications Company shall not be responsible for any action by end-users which exceeds the rights granted

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4. For the name of the prize winners (available after August 30, 1993), send a separate, self-addressed, stamped No. 10 envelope to Programmer's Utility Contest Winners, PC Magazine, One Park Avenue, New York, NY 10016, or see the Programmer's Forum on ZiffNet

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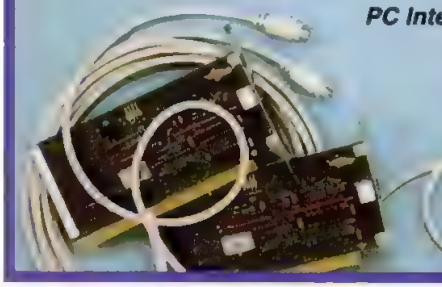

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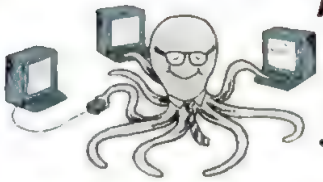

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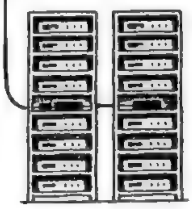

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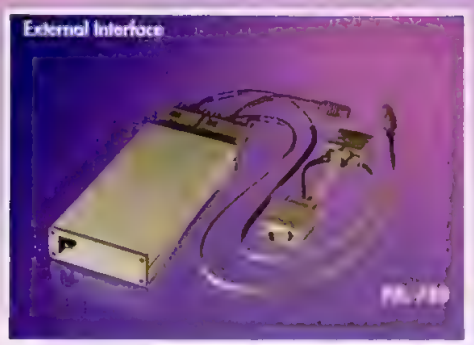

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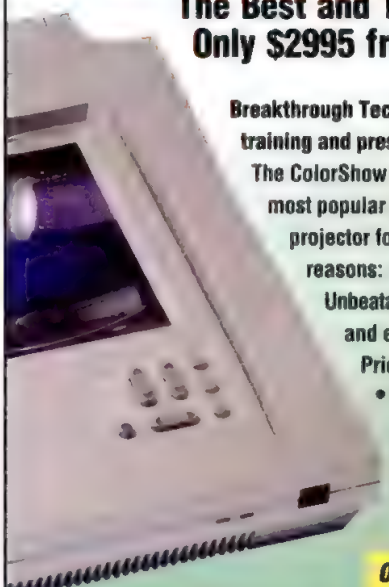

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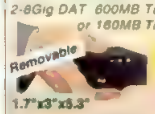

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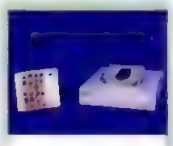

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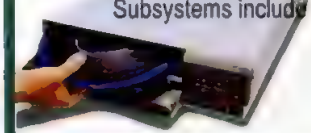

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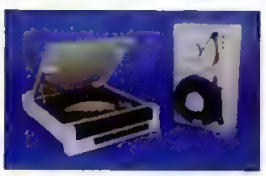

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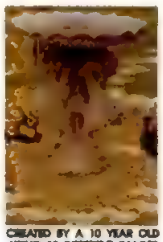

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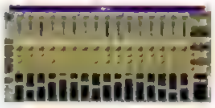

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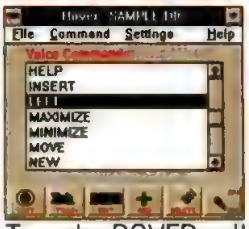

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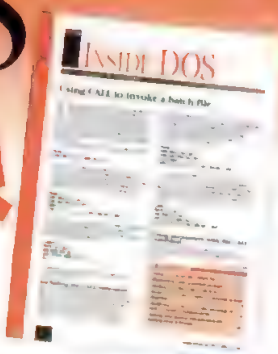

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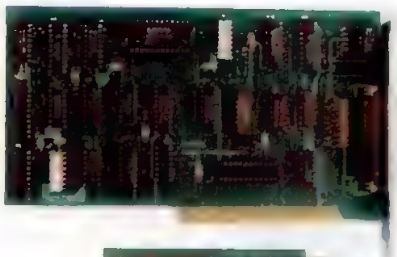

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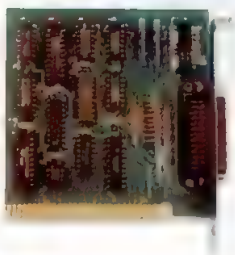

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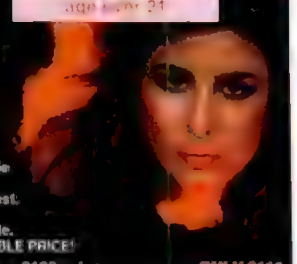

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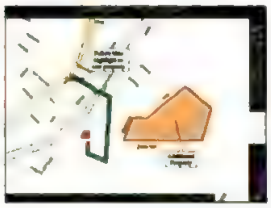

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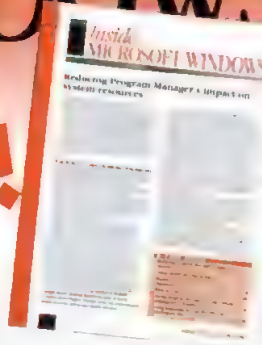

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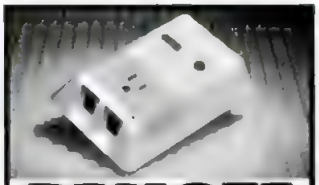

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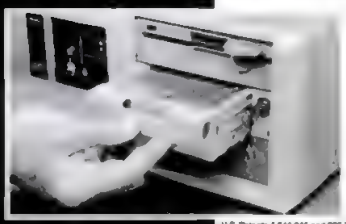

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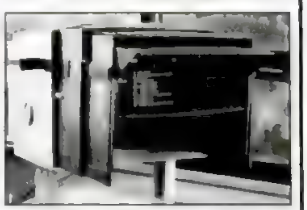

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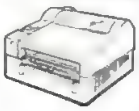

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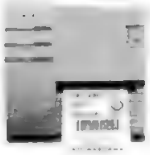

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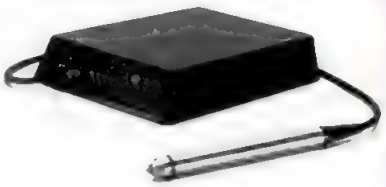

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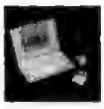

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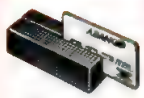

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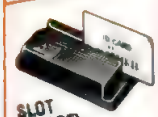

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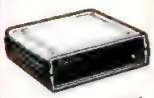

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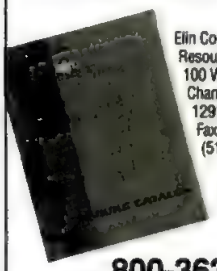

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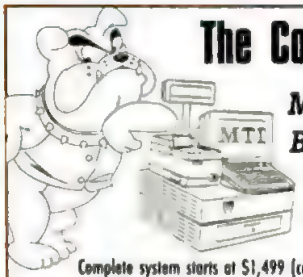

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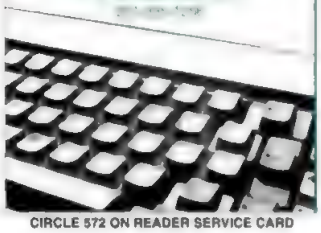

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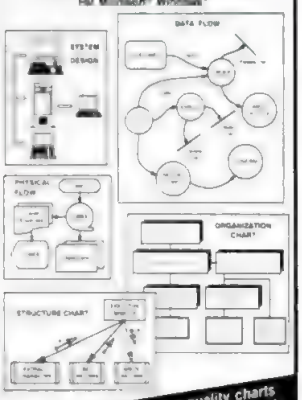

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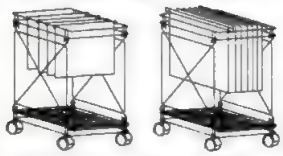

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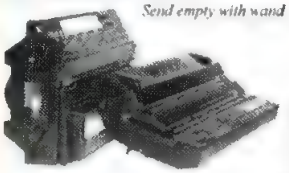

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1. Do you work in a DP/MIS dept.?
01. ☐ Yes 02. ☐ No

2. Please indicate your company or organization's primary business activity: (Check one)
01. ☐ Manufacturer Computer Equip., Computers, Software
02. ☐ Manufacturer–Aerospace
03. ☐ Manufacturer–Other
04. ☐ Systems House
05. ☐ Computer Consultant
06. ☐ Computer Retailer/VAR/VAD Distributor
07. ☐ Communications
08. ☐ Finance/Banking/Insurance/ Real Estate/Accounting
09. ☐ Education
10. ☐ Government
12. ☐ Research and Development
13. ☐ Data Processing/Computer Service
14. ☐ Health/Medical/Legal Service
15. ☐ Engineering/Architecture
16. ☐ Agr./Const./Mining/Oil/ Transp./Utilities
17. ☐ Non-Computer Retailer/Dist.
18. ☐ Other Business or Service

3. Please indicate your primary business function: (Check one)
01. ☐ DP/MIS
02. ☐ Systems, Programming
03. ☐ Communications
04. ☐ Engineering
05. ☐ Res./Dev./Scientific
06. ☐ Accounting/Finance
07. ☐ Computer Consulting
08. ☐ Purchasing
09. ☐ Operations
10. ☐ Production
11. ☐ Education/Training
12. ☐ Marketing/Sales
13. ☐ Medical/Legal
14. ☐ Admin./Mgmt.

4. Is your company a reseller?
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:
01. ☐ 10 or less 03. ☐ 26-99
02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?
01. ☐ Linked to mainframe
02. ☐ Linked to mini
03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply)
01. ☐ IBM or Compatible PCs
02. ☐ IBM or Compatible Mainframes
03. ☐ IBM or Compatible Minis
04. ☐ Macintosh
05. ☐ CD-ROM
06. ☐ Windows

8. Do you plan to buy any PC products?
01. ☐ Now 03. ☐ In 7 to 12 months
02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company:
01. ☐ 25 or less 03. ☐ 100-499 05. ☐ 1000 or more
02. ☐ 26-99 04. ☐ 500-999

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PC MAGAZINE

Coming Up

Portables Blockbuster

Portables are now available in a stunning variety, from 4-pound subnotebooks to 12-pound suitcase multimedia machines. In search of the machine that best fits your needs, *PC Magazine* tests 68 state-of-the-art color and monochrome portables, including the latest systems from AST, Compaq, and IBM. We'll also take a look at Apple's PowerBook and new Duo to see how they stack up against the IBM-compatibles.

Portable Printers

A laptop is only half of the portable office. For a real simulation of office conditions when you're on the road, you'll want a portable printer as well. And portable printers aren't just for the road—they can be space-saving, cost-efficient alternatives to bulkier printers for the space- and cost-conscious office. *PC Magazine* tests the latest choice of printers under 10 pounds that support IBM Proprinter, Epson FX, or PCL emulations.

Wireless Information Services

That rumble you hear over the horizon is tomorrow's work force, on the move but in touch with everyone at all times. Welcome to the world of wireless, the technology that promises to simultaneously free you from the office and make sure you're never out of touch. Our technology overview examines the current market offerings and analyzes what they will mean to you in the not-so-distant future.

Contact Management Software

Next issue, *PC Magazine* looks at the one-product category that has really changed the way people take care of their business: contact management software. We'll show you which products can help you easily maintain your ever-growing list of contacts and clients, track recent interactions, and—among other things—organize your working world.

Free Utility

Between large hard disks and the myriad programs that fill them, it's easy to wind up with two programs with the same name. Generally, this isn't a problem until you try to execute one program but get another—and until you try to find the duplicate. Most likely it's a program you've long since forgotten you had and one that's buried deep in your directory structure. FINDEXEC will help you track down that program and tell you where it's located. And if it's a Windows or OS/2 program, FINDEXEC will find any DLLs it requires to run.

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After Hours

ASTRONOMY: Dance of the Planets, Distant Suns, Epoch 2000, Expert Astronomer, PC-Sky: The Sky Simulator, The Sky

ASTRONOMY

Stargazers' Delight: Six Programs For Astronomy Hobbyists and Pros

BY DONALD B. TRIVETTE

Until recently, amateur astronomers had two main tools: telescopes and an assortment of books. Now, powerful desktop computers and inexpensive software have added a whole new perspective to man's study of the universe.

We took a look at six astronomy programs (three for DOS, three for Windows) that range in sophistication from the near-professional Dance of the Planets to the simple but powerful The Sky. These programs allow you to do many things that you can't do with a book: customize star maps for your own latitude and longitude, display stars by magnitude, and, best of all, send this data to your printer.

Each excels in one or more areas; selecting one is a matter of matching one with your interests, experience, and budget. Dance of the Planets is great for the experienced astronomer, but probably too powerful for the rank amateur. Distant Suns is easy to use, and the CD-ROM version has many high-resolution images. Epoch 2000, with professional features such as telescope control, has powerful tools for charge-coupled device (CCD) image processing and enhancement. The Sky is our own favorite: powerful enough to do the things we wanted it to do and intuitive enough so that we did not get lost in space. PC-Sky does a good job of simulating the night sky as most people actually see it—diminished by city lights and haze. Expert Astronomer may be adequate for the curious beginner: Its user interface is poor, but it has many features of the others, and it costs only $14.95. Happy stargazing.

ARC SCIENCE SIMULATIONS

Dance of the Planets

Dance of the Planets, a comprehensive working model of our solar system, excels both in accuracy and in the number of events it can simulate.

The standard package, from ARC Science Simulations, comes with 10,500 stars, 6,000 asteroids, and all 88 constellations. Two views are available: The conventional earth view simulates what you can see from any location on earth at any time from 4,680 B.C. to 10,000 A.D., and the 3-D space view lets you study our solar system as you might from a spaceship positioned 25 billion miles from earth. The advantage to the latter view is that you can appreciate the beautifully coordinated planetary motion that inspired the name of this software.

A TRIP TO BABYLON

Dance of the Planets gives astronomers more than just comprehensive star maps. It has the tools and resources for the serious study of astronomy. You can, for example, set up and observe the outer satellites of Jupiter as they are affected by the sun's pull, go to Babylon and watch the solar eclipse of 136 B.C., or experiment with hypothetical asteroids to demonstrate the Kirkwood gap.

For a more general lesson, you'll want to explore the program's simulation feature. One interactive tutorial provides a riveting illustration of some basic concepts of astronomy and our solar system; a second demonstrates features of the software itself.

Powerful: Dance of the Planets lets you travel through time to witness significant celestial events.

If you want more stars and events than Dance of the Planets itself offers, ARC also sells a database of an additional 45,000 stars ($35) and an online almanac, Observer's Companion ($30), to help you track celestial events. Observer's Companion calculates the occurrence of celestial events such as lunar and solar eclipses, meteor showers, lunar conjunctions, and occultations of stars and planets. Select the Solar Eclipse option, for example, and enter a time period—say, from 1950 to 2010. Observer's Companion will calculate all solar eclipses for the period and show the degree of visibility from your location.

Dance of the Planets lacks only one feature that would help the casual stargazer: an orientation as could be seen looking out at the horizon with north, south, east, and west views. Instead, the program shows the sky as though you are lying on your back and looking directly up.

The program's menus are well-organized. In this version, you can use the mouse as well as the keyboard to pan and retrieve information about a star or planet. Still, the program's interface is somewhat less intuitive than that of some of the others looked at here.

Dance of the Planets has more features and events than the other packages we reviewed. Though it will probably be a little overwhelming for the casual stargazer, it will most likely appeal to the demanding astronomer.

Dance of the Planets, *$195 ($260 with all options).*
Requires: *640K RAM, 1.2MB*

Dance of the Planets

hard disk space, DOS 3.3 or later. Mouse and coprocessor recommended. ARC Science Simulations Inc., P.O. Box 1955, Loveland, CO 80539; 800-759-1642; fax, 303-667-1105.

Circle 464 on reader service card

VIRTUAL REALITY LABORATORIES

Distant Suns

Distant Suns, Version 2.0, is a Windows-based planetarium designed for students and curious stargazers, and is one of the most attractive astronomy packages in this group.

Along with the planets in our solar system, the constellations, and 9,100 stars, the software includes comets, asteroids, and more than 450 deep-space objects from the Messier and NGC catalogs, two standard encyclopedias of the stars.

The CD-ROM version ($149.95) contains more than 1,300 photos from NASA and the planetary probes, compared with about 18 high-definition images and 200 thumbnail photographs in the disk-based package ($69.95).

Whichever medium you choose, Distant Suns excels in its ease of use and in its images. The earth view in particular is magnificent. The sky fills with stars that are accurate in position, motion, and magnitude. The program even duplicates the subtle star colors found in the night sky.

User-friendly: Distant Suns makes navigating through the night sky easy and intuitive.

INTUITIVE INTERFACE

Celestial navigation is particularly intuitive. A toolbar down the left edge of the screen contains buttons that allow the user to lock onto easily identifiable objects such as the sun and moon. Other buttons allow you to pan to north, south, east, and west views; change the field of view from 60 to 90 to 180 degrees; and advance or retard time so you can see daily changes in the sky. Users can also change these parameters from the pull-down menus.

The methods of finding an object in Distant Suns are intuitive, too. A Find command helps locate specific objects quickly and easily. The command "Find Mars," for example, produces the red planet centered on the screen. You can also note a star's approximate elevation and compass direction in the sky, then duplicate the view on Distant Suns. A green line divided into 360 degrees represents the earth's horizon, and a vertical line, also marked by degrees, gives an object's elevation above the horizon.

Once you locate the star, click on it using the mouse to open a fact window with the star's common name, astronomical identifier, magnitude, position, and other information. If photographs are available, you can view them from the information window. Many of these photographs are spectacular, although Distant Suns lacks a mechanism to turn pages. Instead, you must select each picture from the photo menu.

An Events menu calls up and animates a dozen astronomical events, such as the July 11, 1991 eclipse; a representation of the sky on the evening of February 18, 1930, when Pluto was discovered; and a demonstration of lunar phases. In addition to the canned events, you can make and save your own presentations.

The Guides menu brings up a lunar map, lunar phases, planetary positions, rise/set times, and an ephemeris calculator. These features aren't as complete as the Observer's Companion in Dance of the Planets, but they do provide a handy reference.

An off-earth mode shows a three-dimensional view of the solar system from billions of miles in space. Although not as flexible as the space view from Dance of the Planets, it provides a clear animation of how the planets orbit the sun.

Beautiful images and fast, intuitive navigation put Distant Suns high on our list.

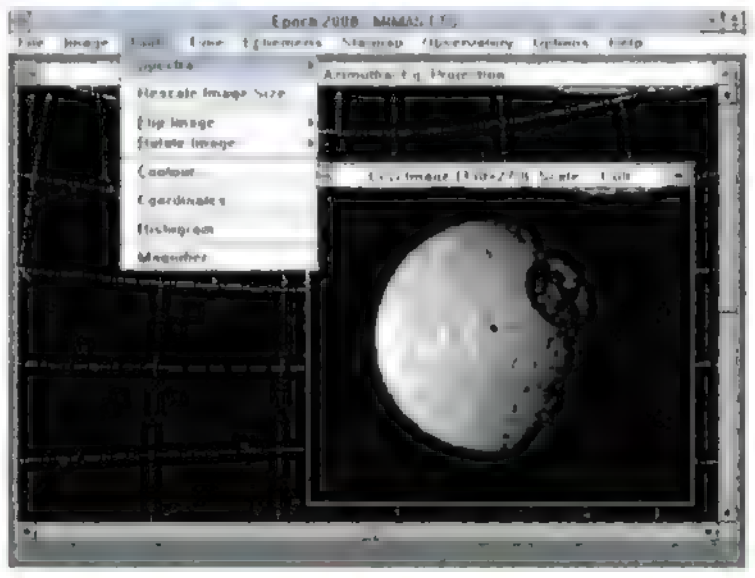
Distant Suns, Version 2.0, *$69.95; CD-ROM version, $149.95.* Requires: *4MB RAM, 5.2MB hard disk space, Microsoft Windows 3.x, CD-ROM drive. Virtual Reality Laboratories Inc., 2341 Ganador Ct., San Luis Obispo, CA 93401; 800-829-8754, 805-545-8515; fax, 805-781-2259.*

Circle 465 on reader service card

FARPOINT RESEARCH

Epoch 2000

Epoch 2000, from Farpoint Research, is a professional desktop observatory with a special emphasis on digital photography and image enhancements. The base-priced version of this Microsoft Windows–based software displays about 45,000 stars, 7,500 asteroids, and 600 comets, along with more than 13,000 clusters, nebulae, and several other deep-space objects.



Epoch 2000 specializes in the ability to manipulate high-resolution digital images of the stars.

Epoch 2000's observatory portion offers two sky views for star maps. One, a spherical projection, presents a view with minimal distortion, but it requires more time to generate. You'll use this view when you want to examine a small section of the sky. The second view, an azimuthal equidistant projection, lets you generate maps more quickly and easily orient yourself in the sky.

Epoch 2000 is known for its huge star base and high degree of accuracy. Positions are calculated to within a fraction of an arc second. This makes it feasible for the software to drive a telescope.

IMAGE MANIPULATION

Besides being a first-rate observatory, Epoch 2000 has tools that allow serious astron-

Epoch 2000

omers to take pictures of the sky and then manipulate these photos. To create these high-resolution charge-coupled device (CCD) images, you need to attach a digital camera to a telescope. The image manipulation software gives the user access to techniques such as dynamic scaling, histogram equalization, convolution, and unsharp masking, all of which are normally found in stand-alone image-processing programs. A merge feature lets you combine separate red, green, and blue images into a full-color composite image.

Expert Astronomer provides the basics for amateurs, but hides them in a hard-to-use interface.

A third feature of Epoch 2000, called the Remote Telescope Network, is currently under development. When this feature is complete, users will be able to call up and control the 24-inch telescope at the Mt. Wilson Observatory in California. You will be able to send and receive CCD images over a high-speed modem.

Epoch 2000 is ideal for those interested in controlling a telescope and taking CCD images. Its power and sophistication will appeal more to serious astronomers than casual stargazers.

Epoch 2000, *$329.* Requires: *4MB RAM, 5MB hard disk space, Microsoft Windows 3.x; math coprocessor recommended. Farpoint Research, 10932 Hasty Ave., Downey, CA 90241; 800-858-9795, 310-861-6606; fax, 310-862-1546.*

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EXPERT SOFTWARE INC.

Expert Astronomer

Expert Astronomer, from Expert Software, is a budget-priced package with a surprising number of features, but a less than ideal interface. For $14.95, this package provides a star base with about 9,000 objects, including stars, constellations, and planets. It lacks some of the objects we saw in other astronomy packages, however.

Navigation around the star map could be better. Panning and zooming usually requires the use of the function keys and menu at the top of the screen. Although you can change the compass and elevation by using a mouse to control the two clock indicators, which are located on the side of the screen, I found this method to be cumbersome and imprecise in this program. This is a not-quite-ready-for-prime-time user interface.

EASY-TO-FIND STARS

On the other hand, Expert Astronomer's Find command makes it easy to locate a particular star or constellation in the sky. Placing the cross-hair cursor on a star displays the star's common name, catalog identifications, and magnitude in the lower corner of the screen. A short green line represents the horizon, and a graticule marks degrees to help gauge distances between stars. Another option turns on a camera frame calibrated for lens size so you can plan for photographic observations.

Although Expert Astronomer has a poor interface and is somewhat less polished than the other products, it may well be the only astronomy software you need if your main aspiration is to identify the stars you see when walking the dog. For a mere $15, it's hard to go wrong.

Expert Astronomer, *$14.95.* Requires: *512K RAM, DOS 3.0 or later. Expert Software Inc., 800 Douglas Rd., North Tower, #355, Coral Gables, FL 33134; 800-759-2562, 305-567-9990; fax, 305-443-0786.*

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CAPELLASOFT

PC-Sky: The Sky Simulator

PC-Sky: The Sky Simulator, from CapellaSoft, attempts to simulate what you can see in the night sky with the naked eye or with binoculars. Its star base has about 26,700 objects, including double-star systems, variable stars, and binaries.

When you first start the DOS-based PC-Sky, you select your longitude and latitude. What distinguishes this package from the rest, however, is that you get to choose the setting that describes your own point of observation—urban, mountain/desert, country, or suburban. From this data, PC-Sky figures out which stars you can see and which you can't. This greatly simplifies identification and location for novices.

PC-Sky: The Sky Simulator shows visible stars based upon their location and setting.

Panning the sky is accomplished with the function keys (F1 is north, F8 is northwest, for example); alternatively, you can use the mouse to pan. The cursor is shaped like a circle, and positioning it on a star immediately brings up the name and a few facts. This is the best approach to celestial identification we've seen.

Once you've located an area of sky with your naked eye, you click the mouse to zoom in for a binocular view and click again for a telescopic view. Each view is progressively more magnified.

Although PC-Sky is simple to use and has features we really like, it also lacks some basics that we've come to expect. There are no constellation lines and no grids to overlay the sky and help determine elevations and locations. The developer explains, rather weakly, that these things aren't in the real sky, either. In addition, each star's information is limited to name, magnitude, and location.

We also found that on our system, PC-Sky's stars were a little dim. A 256-color mode provides brighter star resolution than does the 16-color

PC-Sky

mode, but a programming error caused it to conflict with the Microsoft mouse, so we had to run the program in the dimmer mode.

PC-Sky: The Sky Simulator, *$99.* Requires: *640K RAM, 3.5MB hard disk space, DOS 3.3 or later. CapellaSoft, P.O. Box 3964, La Mesa, CA 91944; 800-827-8265, 619-460-8265.*

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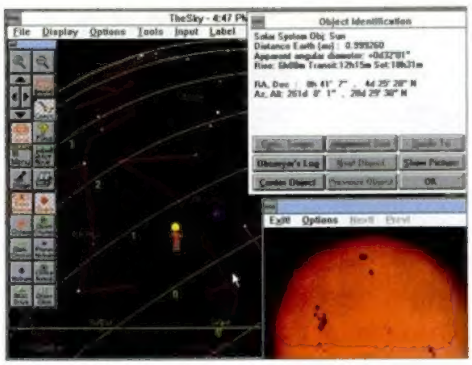
SOFTWARE BISQUE

The Sky

The Sky, from Software Bisque, resembles Distant Suns in organization and structure, but has a few additional features. The low-end version of The Sky has 55,000 objects, while the high-end version of the package contains more than 270,000 objects. Both contain more than 70 high-resolution images of the planets.



As the world turns, so does The Sky. This package updates and redraws star maps every 30 seconds.

Like Distant Suns, this Windows-based package contains a toolbar along the left edge of the screen. Using toolbar buttons, you can turn on and off such objects as constellations, planets, nebulas, and galaxies. These buttons also control zoom and direction and help you find any object.

Star maps can be displayed in any of five equatorial projections (north polar, south polar, Mercator, modified Mercator, and spherical) and two horizontal projections (spherical and above horizon). We found the horizontal projections ideal for orienting ourselves.

One of The Sky's most attractive features is its ability to redraw the star maps automatically every 30 seconds: If you want to examine the view out your window, you can leave the program running, and the screen will match your view on your return.

Double-clicking on a star or planet brings up an information window describing and identifying the object. Buttons within that window allow you to view available images and log your own observations and descriptions.

The Sky contains a simplified 3-D animated representation of the motions of the planets, but nothing as elaborate as the ones found in Dance of the Planets and in Distant Suns.

For the novice, this program is the easiest to use.

The Sky, *$129 (high-end version, $199).* Requires: *4MB RAM, 9MB hard disk space, Microsoft Windows 3.x. Software Bisque, 912 Twelfth St., Golden, CO 80401; 800-843-7599; fax, 303-278-0045.*

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MOVING?

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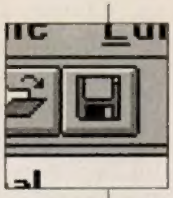
Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

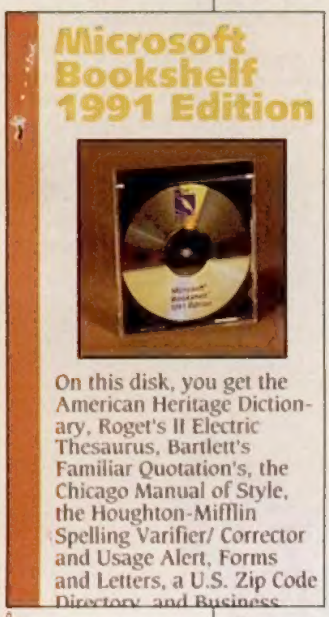


WinWord's Parallel Universe

Have you noticed that the Save icon on the toolbar of Microsoft Word for Windows shows a 3.5-inch floppy disk that's backwards?

Attention All Monty Python Fans Who Program

If you look under D in the index of the Borland Turbo Vision manual, you'll find this listing: "Dead parrots, see 'Parrots, dead.'" Alas, under P there is no "Parrot" listing.



On this disk, you get the American Heritage Dictionary, Roget's II Electric Thesaurus, Bartlett's Familiar Quotation's, the Chicago Manual of Style, the Houghton-Mifflin Spelling Varifier/ Corrector and Usage Alert, Forms and Letters, a U.S. Zip Code Directory and Business

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Whose Mind Is It, Anyway?

"The performance decrease is actually minimal and well worth the piece of mind you'll get from protecting your Windows print jobs from rude DOS applications."
—*Windows Sources*

Have Fun With Your Leisure-Time Database

This ad proves that databases aren't just for work anymore.

So What Happens When The Product Dies?

An ad for CompuAdd Superstores says that one of the standard features of their PCs is "24-hour toll-free support for life of product."

Richard Tennant

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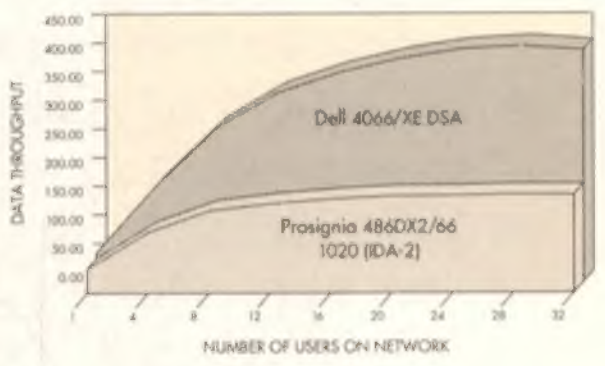

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